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A HISTOLOGICAL STUDY OF 50 UTERI REMOVED AT CÆSAREAN SECTION.*

By J. Whitridge Williams,

Professor of Obstetrics, Johns Hopkins University and Obstetrician-in-Chief to The Johns Hopkins Hospital.

During the past 20 years we have had occasion in my service to amputate the body of the uterus supravaginally and to treat the stump extraperitoneally in 50 cases following delivery by Cæsarean section. In each instance the specimen has been preserved and subjected to careful histological examination.

The study of this comparatively large material has yielded important information concerning a number of questions; more particularly concerning the mechanism of the separation of the placenta and of the fœtal membranes; the amount of decidual retained immediately post partum; the vascular changes at the placental site; the retraction of the uterine muscle; the occurrence of ascending infection in patients who had been long in labor, or who had been repeatedly examined by persons neglecting rigorous hand disinfection; and finally concerning the characteristics of the cicatrix resulting from previous sections, and its bearing upon the correctness of the dictum—"Once a Cæsarean always a Cæsarean."

I have thought that a brief analysis of my findings might prove of interest, more particularly as they are not in accord with certain current teachings, and as they show that many of the statements concerning the third stage of labor contained in the text-books are too arbitrary and general.

At first glance, it might appear that we have been too liberal in the indications for the performance of an operation, which necessarily puts an end to the reproductive process; but, although I am prepared to admit the justice of the criticism for a small number of cases, I contend that impartial study of the indications will show that our practice has been generally conservative. In view of my experience that the convalescence following this operation is more satisfactory than that following the classical section, except when done at an appointed time at the end of pregnancy or at the very onset of labor, we have in the past employed it in cases in which we would now resort to pubiotomy or extra-peritoneal Cæsarean section. Furthermore, until very recently, we have employed it as the operation of choice in all cases in which it was thought advisable to prevent further conception. Accordingly, we have

*Read in abstract, with lantern demonstration, before the American Gynecological Society, June, 1917.

resorted to it in many patients who required a second or third Cæsarean section, as well as in those suffering from serious heart lesions, in whom a repetition of pregnancy bid fair to put the patient's life in serious jeopardy. Finally, we have employed it in certain feeble-minded or profoundly deformed individuals in whom repeated pregnancy seemed undesirable from an economic or social point of view.

At present, in these latter types of cases we bring about sterility by double ligation and section of the tubes followed by the burial of their proximal ends between the folds of the broad ligaments, and restrict the use of supravaginal amputation to frankly infected cases and to those presenting definite uterine lesions.

Analysis of our series of cases shows that the operation was undertaken for the following indications:

	Cases.
Repeated Cæsarean sections	10
Frank infection	8
Rupture of uterus	5
Serious heart lesions	4
Atresia of cervix	3
Intramuscular hæmorrhage associated with premature separation of the placenta	2
Myoma of the uterus	2
Atonic hæmorrhage	2
Pregnancy in a rudimentary horn	1

a total of 37 cases, leaving a balance of 13 cases in which the operation was undertaken for various other indications. Looking backwards, I acknowledge that supravaginal amputation may have been unnecessary in a small number of the latter group of cases, but for the great majority I contend that it was a fully justifiable procedure.

Before taking up the analysis of the histological findings in our series of specimens, a few words concerning the structure of the pregnant uterus at term, of the placenta, and of the membranes outside of the placental site, will make it easier to understand the changes occurring during the third stage of labor.

Fig. 1, which represents the left half of the uterus of a woman who died from eclampsia, without convulsions, prior to the onset of labor, shows the tightly contracted empty bladder, a portion of the vagina and the unchanged cervix. Its most instructive portion, however, is the body of the uterus, with the placenta attached to its upper and anterior portion. The uterine walls were tightly contracted over their contents, as is shown by the impression of a foot of the child upon the internal surface of the placenta. Outside of the placental site the interior of the uterus is lined by the fœtal membranes; and except at one point on the posterior wall, the most surprising feature is the extreme thinness of the uterine walls, which including the fœtal membranes and decidua vary in thickness from 1.5 mm. in the lower uterine segment to 3 or 4 mm. at the placental site. This is in marked contrast to the conditions existing in the non-pregnant organ and during the first half of pregnancy. In the latter condition, the uterine walls are thick, and the decidua vera measures from 7 to 10 mm. in thickness and presents its characteristic compact and spongy layers. It is apparent that the present conditions can have resulted only from pronounced distention of the uterus by its contents, with consequent thinning of its walls, and therefore one cannot expect to find either the muscle wall or the decidua presenting the same structure as in early pregnancy.

Fig. 2, which represents a section through the wall of a full-term pregnant uterus outside of the placental site, clearly illustrates these points. In the first place, it is seen that the muscularis has in great part lost its felt-like structure and that its fibers are arranged in almost parallel strands. In the second place, it is seen that the fused decidua vera and capsularis, together with the fœtal membranes, form a layer of about 1 mm. in thickness, two thirds of which belong to the former and one-third to the latter. The decidua in great part consists of the compact layer and contains only a few glands. This, however, is not a general rule, as in other specimens this relation may be reversed, when the bulk of the decidua will consist of the spongy layer. The essential point is the relative thinness of the decidual layer, and the fact that it differs greatly from the condition usually described as typical, so that when separation occurs during the third stage of labor it will not always be easy to determine whether it has taken place in the compact or in the spongy layer.

Furthermore, it will be noticed that the junction between the outermost portion of the decidua and the muscularis forms an almost straight line, instead of the serrated junction characteristic of the early months—a point to which Aschoff directed attention in 1899.

When we pass to the placental site, it is apparent that the comparatively thick decidua basalis of the early months has likewise undergone a radical change, and, although it may be thicker than the decidua vera, it rarely exceeds a few millimeters in thickness and may be much thinner. Indeed, no general rule can be laid down in this regard, as it may happen in the same placental site that in places the basalis may be relatively thick and in others almost completely lacking.

Figs. 3 and 4, from other full-term pregnant uteri, clearly illustrate these differences. In the former the basalis is quite thin, contains no glands and is made up of a few layers of partially degenerated decidual cells, interspersed with large fœtal cells possessing deeply staining nuclei. In the latter it is seen that the basalis is sharply differentiated into a compact and spongy layer, and that the latter makes up the greater part of its thickness. It is also seen that the epithelium lining the glands in the deepest part of the spongy layer is well preserved, and is apparently ready to effect the regeneration of the endometrium during the puerperium.

Fig. 5, represents a section through another pregnant uterus at term. In its upper portion it illustrates the fœtal portion of the placenta, with amnion, chorionic membrane, and villi; while in its lower portion it represents the decidua basalis with a trophoblastic or, as it was formerly designated, a decidual septum projecting up into the intervillous space. In this specimen, to the sides of the septum, the decidua basalis is unusually thin and consists almost entirely of so-called fibrinoid or canalized fibrin.

From the study of these three sections, it is apparent that the decidua basalis varies greatly in structure, and consequently it is not justifiable to lay down the general rule that separation during the third stage of labor must take place in the spongy layer. At any rate, such a mechanism would be out of the question in the specimens represented by Figs. 3 and 5, in which a spongy layer was entirely lacking.

Location of placenta.—Passing to the study of our 50 specimens, the first point to claim our attention is the location of the placental site, and our statistics show that the placenta was attached to the anterior wall of the uterus in 18 and to the posterior wall in 32 instances. In 15 of the 50 specimens, the placenta remained firmly attached to the uterine wall after the completion of the operation, while in the other 35 cases it had either separated spontaneously or had been removed manually before amputation of the organ.

In the cases of retention, the placenta was attached to the anterior wall in three and to the posterior wall in 12 instances. The lesser incidence of the attachment to the anterior wall in this group of specimens, as contrasted with those in which separation had occurred, is probably attributable to the fact that when implanted anteriorly it was necessary to incise or to separate the placenta manually before delivering the child.

Uterus Immediately Post Partum.—Immediately after the extraction of the child by Cæsarean section, the uterus with the placenta still *in situ* is delivered through the abdominal wound, and the peritoneal cavity is protected with sterile gauze pads. At this time, the uterus has contracted tightly down upon its contents, and the hæmorrhage is usually minimal. The various procedures preliminary to amputation are now undertaken, and in many instances, while they are in progress, the placenta is spontaneously extruded. In other cases such profuse hæmorrhage may follow its partial separation that manual removal becomes necessary in order to permit the uterus to contract with sufficient force to control the bleeding, but in 15 of the specimens, as has already been mentioned, the placenta and membranes remained *in situ* at the end of the operation.

Consequently, the condition of the uterus will vary according as the placenta has been expelled or not. In the former case the body of the uterus is represented by an almost solid mass of muscle including in its interior the almost completely obliterated cavity, and measures on the average 16 cm. in length, 12 cm. in breadth and 8 cm. in thickness. In other words, the thin-walled muscular sac depicted in Fig. 1, has become transformed into a structure whose walls average 3.5 to 4 cm. in thickness. Strange to say, in this group of specimens, particularly when hardened, it is frequently impossible to identify the placental site with the naked eye, and its location can be determined only after microscopical examination.

In the specimens in which the placenta remains *in situ*, the body of the uterus is still larger, and the comparison of Fig. 1 with Fig. 6, which represents a sagittal mesial section through such a specimen, after hardening, gives a graphic picture of the changes that have occurred. In the first place the thin-walled full-term pregnant uterus has become diminished by about one half in length and thickness and converted into a thick-walled structure, whose cavity is completely occupied by the placenta and the fœtal membranes. The muscular walls have increased to 2.5 to 3 cm. in thickness, while the uterine cavity has become diminished from a huge space to a mere slit between the free surface of the placenta and the anterior uterine wall. At the same time the area of placental attachment has decreased nearly one half in length, while the placenta has increased several times in thickness. Furthermore, the fœtal membranes have been transformed from a structure but little thicker than a sheet of paper into a layer several millimeters thick, which presents a wrinkled appearance and upon closer inspection is seen to be made up of myriads of minute wavy folds or festoons.

In several instances, in which the placenta was inserted upon the posterior wall of the uterus with its upper margin extending well into the fundal region, another phenomenon was observed: namely, the posterior wall, with the placenta still attached, became inverted through the uterine incision. That this was the result of uterine retraction was clearly demonstrated by the fact that on one occasion I observed the same phenomenon follow the sudden contraction of the still warm uterus incident to its immersion in a 10-per-cent solution of formalin.

The consideration of the histological conditions obtaining in the empty uterus will be deferred until later, and we shall now turn to those observed in uteri in which the placenta is still *in situ*. In all of the 15 specimens belonging in this category the placental site had undergone a definite decrease in size, whence it would naturally be inferred that the decidua basalis must have undergone a corresponding thickening. Doubtless, this did occur, but the study of our specimens indicate that it is much less extensive than might have been expected, and still further confirms the statements made above concerning the varying structure of that membrane. Designating the decidua basalis as thick or thin according as it equals or exceeds 2 mm., or measures less than 1 mm., respectively, our figures give the following data: decidua basalis, thick, two cases, thin, seven cases, varying, five cases, and lacking, one case.

The last observation (Specimen No. 713) is of particular interest, as in it the chorionic villi were either attached directly to the muscularis or were separated from it by a very thin layer of canalized fibrin containing a few isolated decidual cells. But in any event, the classical compact and spongy layers were lacking and, had separation occurred, it could not have been described as following the mechanism usually outlined in the text-books.

As has already been mentioned, in all of the specimens in which the placenta remained *in situ*, as well as in a number in which it had been expelled, but in which a portion of the membranes had been retained, the interior of the uterus was lined by a layer of tissue several millimeters thick, which instead of presenting the smooth glistening appearance of the distended amnion offered a dull corrugated surface, which upon closer examination was found to be due to the presence of myriads of minute folds or projections.

Upon microscopic examination it becomes apparent that this appearance is due to the fact that the decidua vera and the chorion laeve had been thrown into delicate waves or festoons, while the amnion, unable to accommodate itself to the process, had become puckered, with the result that its free surface was converted into innumerable papillary excrescences of varying size.

Figs. 7 and 8 give an excellent idea of these changes and offer a marked contrast to the conditions present in the undelivered uterus at term, as shown in Fig. 2.

Careful study of such sections show that the bulk of the decidua vera is contained in the interior of the festoons, and that only a relatively small portion remains in contact with the muscularis; and furthermore, that its line of junction with the latter has become wavy or serrated, so that in many places small triangular masses of decidual tissue, containing well-preserved gland spaces, project down into the interstices between the muscle bundles. In other words, the mutual relation between the two structures has been restored to that which existed in the early months of pregnancy, and which had disappeared with the increasing distention of the pregnant uterus. Processes of chorionic connective tissue covered by many layers of chorionic epithelium, in which remnants of atrophic villi are sometimes visible, project down between the decidual folds and are firmly united to them.

This festooning of the fœtal membranes and the decidua was noted by Dohrn in 1865 and by Ahlfeld in 1881, but was first thoroughly described by Barbour in 1884, whose article was accompanied by excellent colored illustrations. Since then it has been mentioned by various writers, among whom Champneys, Krönig, Keilmann and Gessner may be mentioned. Accordingly, although this observation is not new, I do not think that its significance has been sufficiently appreciated, either on account of its scientific interest or because of its bearing upon the mechanism of the separation of the membranes.

Of course its mode of production is perfectly apparent, and represents nature's method of temporarily adjusting the large superficies of the interior of the full-term pregnant uterus to the restricted area available in the freshly delivered organ. Its bearing, however, upon the mechanism of separation of the membranes, and the regeneration of the endometrium post partum is of prime importance. From a study of the illustrations, it is evident that separation can occur only at the basal ends of the festoons, and that as many of them reach almost to the muscularis and as the bulk of the decidua vera is included between them, only a minimal amount of decidua will ordinarily be left *in utero*. In these circumstances, therefore, separation must usually occur in the deepest layers of the spongy layer, so that the triangular areas of decidual tissue included between the muscle bundles must play a very prominent part in the process of post-partum regeneration.

Corresponding to the diminution in size of the maternal aspect of the placenta, the amnion covering its fœtal surface is frequently thrown into folds, similar to those occurring in the membranes. The chorionic membrane, however, does not take part in the process, and continues to present a smooth fœtal surface.

Mechanism of Separation of the Placenta and Membranes.—As early as 1881, Ahlfeld attempted to study this problem upon the basis of the findings in a uterus removed by Dohrn at a Porro Cæsarean section. As in his specimen the uterine cavity was obliterated and the placenta still firmly attached, he concluded that retroplacental hæmorrhage was not the essential factor in inaugurating the separation of the organ, and he therefore attributed it to the inability of the maternal surface of the placenta to accommodate itself to the constantly decreasing area of the placental site.

Opposition to his teachings immediately developed, and Sänger, Leopold, Kerr and others contended that such pronounced alterations in the action of the uterus must result from the presence of the incision in its anterior wall that it would be inadmissible to assume that phenomena following Cæsarean section, no matter whether the uterus was retained or removed, would necessarily apply to the normal unopened organ.

Barbour and Hart did not share this view, but contended that such observations threw a flood of light upon the normal mechanism of the separation of the placenta. They, as well as Schroeder, Stratz, Nyhoff, and others, held that separation did not normally occur during the contractions of the first and second stages of labor, for the reason that the placenta was firmly pressed against its site of attachment by the general intrauterine pressure, and furthermore, that the moderate diminution in area of the placental site was compensated for by a corresponding decrease in size of the placenta, which was brought about by a part of the contents of the vessels in the chorionic villi being mechanically squeezed into the general fœtal circulation. In the third stage of labor, on the other hand, these factors no longer come into play, and the lack of correspondence between the placenta and its area of attachment becomes greatly accentuated. Barbour contended that this only prepared the way for separation, but that the process was not inaugurated until alternating contraction and relaxation occurred later. Consequently, he attributed the separation to uterine activity, and believed that retroplacental bleeding was only a secondary factor. Hart expressed himself more or less paradoxically, and stated that separation was less the result of diminution in the area of the placental site than of a relative enlargement of the placenta, which resulted from the inability of the vessels of the chorionic villi to rid themselves of their contents.

While I am prepared to admit, at least in part, the justice of the contentions of those who claim that incision and manipulation of the uterus introduce a disturbing factor into the physiology of the third stage of labor, I nevertheless feel that our series of specimens—and particularly those in which the placenta remained *in situ*—give important clews concerning the mechanism of separation.

In the first place, they clearly demonstrate the diminution in the area of the placental site, and show that the placenta, in order to accommodate itself to the process, has increased

markedly in thickness. In the second place, the fact that in nearly one third of the specimens the placenta was still *in situ* and showed no sign of separation or of hæmorrhage beneath it, during the 10 or 15 minutes which had elapsed between the delivery of the child and the amputation of the uterus, clearly demonstrates that retroplacental hæmorrhage does not always appear promptly, and to some extent justifies the assumption that it is not usually the primary factor concerned, but developes secondarily after some other mechanism has inaugurated the separation.

In the third place, the festooning of the fœtal membranes and the decidua gives conclusive information concerning the mechanism of their separation; as it is apparent that the way has been prepared for their detachment by traction or gravity as soon as the placenta has become loosened from its attachment and begins to descend.

On the other hand, our specimens give no information concerning the immediate cause of separation of the placenta, and force us to take refuge in hypotheses if we wish to attempt to explain the entire mechanism of the process. Figure 9, which represents a section through a uterus in which the placenta was partially adherent, shows very clearly the line of cleavage in the decidua basalis, and the relative amounts of it which are cast off with the placenta and retained *in utero*, respectively. Furthermore, the relatively small size of the space between the two layers indicates that the amount of retroplacental bleeding has been minimal.

Location of Separation of Placenta and Membranes.—Although Matthews Duncan, in 1868, had given an extensive historical résumé of the work done upon this subject, in which he pointed out the fallacy of the older view that the entire mucosa was cast off at the time of labor and showed that considerable portions of it were normally retained and served for the regeneration of the new endometrium, it was not until after the appearance, in 1870, of Friedländer's classical work upon the structure of the decidua that interest in the question became acute. As is well known, this writer gave an accurate description of its histological structure, and established the differentiation between the compact layer adjoining the uterine cavity and the spongy layer adjoining the muscularis. He also stated that at the time of labor separation normally occurred in the deeper portion of the compact layer, so that a thin remnant of it as well as the entire spongy layer was retained.

This doctrine remained uncontradicted for five years, when Langhans stated that it was quite erroneous, and that the line of cleavage normally occurred in the spongy layer, so that only the fundi of the glands were retained and were available for the regeneration of the endometrium. As the extensive work of Kundrat and Engelmann and of Leopold upon the structure of the endometrium in its various phases was published about the same time and confirmed Langhans' views, it has been generally accepted that separation normally occurs in the spongy layer, and this teaching has been incorporated into the text-books.

Friedländer did not allow Langhans' teachings to go unchallenged, and in 1878, reiterated his original view, at the same time giving a description of a specimen in which the entire decidua had been retained after the extrusion of the placenta. Various other writers took a more conservative position; thus, Küstner and Fehling held that cleavage might occur in either layer, and Caratulo stated that it occurred in the spongy layer at the placental site and in either the compact or spongy layer elsewhere in the uterus. Barbour, on the other hand, believed that the significance of the spongy layer had been greatly exaggerated, while Krönig, in 1901, expressed surprise at finding how little decidual tissue was normally retained.

In view of these contradictory statements, the findings in our series of specimens may be of interest. As has already been gathered from the description of the placenta and membranes before delivery, it is apparent that uniform conditions do not always obtain and that the structure of the decidua basalis and vera at term differ so markedly from those existing in the early months of pregnancy that it is to be assumed that the conditions found immediately post partum would not correspond with those postulated by the assumption that Friedländer's classical description of the structure of the decidua persists throughout the entire duration of pregnancy.

Our findings fully bear out these *à priori* deductions, as 40 of our specimens are available for solving the question. They show that separation had occurred entirely in the compact or in the spongy layer in 7 and 28 instances, respectively; while in five other instances the separation was irregular, occurring in some areas in the compact and in others in the spongy layer.

Still more definite conclusions may be deduced from the study of the 35 specimens in which the placenta and membranes had separated before amputation of the uterus. Thus, sections through the placental site show that the portion of decidua retained could be designated as thick in 10 and as thin in 10 other specimens. In an additional instance no trace of decidua could be found, while in the remaining 14 specimens the amount retained varied, being thick in some places and thin in others, and entirely lacking in still others, except for the minimal amounts contained in the triangular areas extending down between the fibers of the retracted muscularis.

Fig. 10, gives a good idea of the conditions obtaining when cleavage has occurred in the compact layer, and the poor preservation of the glandular epithelium, except in the immediate vicinity of the muscularis, makes it evident that everything above it will probably be cast off in the lochia before the process of regeneration is inaugurated. Figures 11 and 12, which are diagrams from sections through different portions of the placental site of another uterus, give a clear idea of the varying amounts of decidua basalis which may be retained in the same organ. Furthermore, sections outside of the placental site show that analogous variations occur in the decidua vera. Thus, the retained portion was found to be thick in 11, thin in 7 and of varying thickness in 17 instances.

In other words, our study shows that hard and fast rules cannot be laid down concerning the line of cleavage during

the third stage of labor or, as to the amount of decidua which will be retained at the placental site or elsewhere in the uterus. In some cases cleavage occurs definitely in the spongy layer, less frequently in the compact layer, but very often it is irregular, involving the spongy layer in some places and the compact layer in others. Consequently, the amount of decidua retained may vary greatly in different specimens, and all gradations may be observed varying from a thick layer on the one hand to minute decidual triangles between the serrated margin of the muscularis on the other.

Placental Site.—The structure of the decidua basalis both before and after the separation of the placenta has already been studied, but several histological points of interest in this area remain to be considered—particularly the occurrence of fœtal cells and certain vascular changes.

In a previous section of this report reference was made to the fact that in not a few specimens it was impossible to locate the placental site macroscopically, and that its location could only be established after microscopical study. In such cases neither the amount of decidual tissue retained nor the increased vascularity enables one to make a decision, which in our experience depends almost entirely upon the recognition of fœtal-cell infiltration or of certain vascular changes, which only occur in this locality.

As early as 1865 Dohrn described in the decidual basalis the presence of large cells with deeply staining nuclei which stood out in marked contrast against the typical decidual cells. Friedländer and Leopold observed similar structures, which the latter described as decidual giant cells, and held that their active invasion of the vessels played a causal part in the production of the thrombosis, which he believed was essential to the onset of labor and to the prevention of post-partum hæmorrhage.

Since then these cells have been studied by numerous investigators, among whom Pels-Leusden, Winkler, Pinto, Aschoff and Schickele may be mentioned. They vary greatly in size and shape, but possess the common feature that their nuclei contain an abundant chromatic network which stains deeply with various reagents. The cells may be spindle-shaped, round, polygonal or irregular in outline and sometimes contain several nuclei. They occur only at the placental site, but are not limited to the decidua basalis, as they may extend far down into the muscularis, usually in connection with strands of connective tissue accompanying the blood-vessels. They begin to appear in the early weeks of pregnancy, attain their maximum development somewhere between the fourth and fifth months, usually persist throughout the balance of pregnancy, and disappear during the first week of the puerperium.

It would lead too far afield to consider their history and significance, and it must suffice to say that, while Pels-Leusden, Winkler, Pinto and others hold that they are maternal in origin, the great majority of authorities consider that they are wandering fœtal cells derived from the chorionic epithelium, in which opinion I concur.

Such fœtal cells were present in the placental site in 35 of our 50 specimens, and in a number of instances, as has already been indicated, were the principal factor in leading to its identification. Their presence in 70 per cent of our specimens effectively disposes of the statement of those authors, who contend that they disappear normally before full term is reached.

As has already been indicated, Friedländer, and more particularly Leopold, directed attention to the invasion of venous channels in the placental site by the so-called decidual giant cells. They held that the process originated in the later days of pregnancy, and was the main factor concerned in the production of thrombosis, which they believed played an important part in the causation of labor and particularly in the prevention of hæmorrhage after the extrusion of the placenta. Since then the regular occurrence of such thromboses has been generally accepted and taught.

The study of our specimens, however, has shown that such teachings are erroneous, and while thrombosed vessels can always be found at the placental site of women dying during the puerperium they are usually lacking in freshly delivered uteri. Our statistics show that they were present in 11 of our 50 specimens, but in every instance the thrombi were fresh, merely consisted of recently clotted blood, and showed no evidence of organization. Consequently, I feel justified in concluding that thrombosis is not a characteristic feature of the freshly delivered uterus, that when it occurs it is a secondary process incident to the cutting off of the circulation, and that it cannot be regarded as the prime factor in the control of bleeding.

On the other hand, certain other vascular changes occur in the decidua basalis and the subjacent muscularis with much greater regularity, and when present clearly indicate the location of the placental site. These changes consist primarily in the conversion into fibrinoid tissue of the walls of both arterial and venous vessels. In this tissue the outlines of cells in various stages of preservation may be detected, while occasionally masses of similar cells lie directly beneath the endothelial lining, and exceptionally occupy the lumen as well. In some cases the lumen of the vessel is preserved, but in others it is encroached upon by the collapse of its degenerated walls with the result that hyalin structures of bizarre outline are formed, which are suggestive of somewhat similar formations observed in the ovary. In still other instances, the exterior of the vessel consists of an irregularly shaped ring of hyalin or fibrinoid material enclosing a mass of loose connective tissue, in whose center is a small and often irregularly shaped lumen, which is lined with apparently normal endothelium; while in other instances all trace of the lumen has disappeared.

These changes were noted in 27 of our 50 specimens, and while the study of a series of pregnant uteri shows that they are observed most frequently in the last months of pregnancy, they are nevertheless sometimes present during its first half. As far as I can learn these changes were first described by Patenko in 1879, but failed to create any considerable interest until recently. Since 1910, however, they have been exten-

sively studied by Frankl and Stolper, Schickele, Heckner, Hinselmann and others, but no general agreement has been reached as to their mode of production, although the prevailing opinion is that they are due to the invasion of the vessel walls by fœtal elements with subsequent fibrinoid degeneration.

I am not prepared at present to express a definite opinion as to their mode of production or significance, but I expect within a reasonable time to publish a communication upon the subject, which I hope will aid in its solution. Consequently, all I can say at this time is that they were noted in more than one half of our specimens, and that in doubtful cases their presence has sometimes been the definitive factor in identifying the placental site.

I shall likewise say nothing concerning the obliteration of arteries outside of the placental site, of their regeneration in subsequent pregnancies, nor of the increase in elastic tissue which is associated with the process. These changes have been considered in detail by Balin, Pankow, Szasz-Schwarz, Goodall and others, but my opinions concerning their significance are as yet too hazy to permit me to make definite statements concerning them.

Muscular Retraction.—In considering the structure of the full-term pregnant uterus depicted in Fig. 1, attention was directed to the excessive thinness of its muscular walls, and to the fact that their fibers had lost the felt-like structure characteristic of early pregnancy and had become arranged in almost parallel strands. Coincidently with the emptying of the uterus at the time of labor and the great increase in the thickness of its walls, the arrangement of the muscle fibers undergoes immediate change, and microscopical examination shows that the individual muscle cells have become considerably diminished in length and increased in thickness. Coincidently with this change the muscle bundles have lost their more or less parallel arrangement and now pursue an irregular and complicated course. In many instances the fibers are markedly curved, suddenly bend at acute angles, and in general interlace in such a way as to make it impossible to describe their course.

This change, of course, is incident to the contraction and retraction of the organ, and was clearly noted in 42 of the 50 specimens.

Inflammation of the Decidua.—In the first section of the article attention was directed to the fact that in 8 instances the indication for the removal of the uterus consisted in frank intra-partum infection. In all of these cases, microscopical examination revealed the existence of acute inflammatory changes in the decidua. In every instance, the process was most intense in the lower uterine segment, thus indicating that the infection had ascended from below. In a number of instances the placental site was involved in the process, and there is every probability that a considerable number of the women would have presented severe, if not fatal, infection in the puerperium had the uterus not been removed, and thus additional evidence is afforded of the wisdom shown in adopting a radical course.

In addition to the eight cases just mentioned, definite inflammatory changes were noted in 12 other specimens. These were all derived from patients who had been examined by outside physicians before admission to the service, or in whom for one reason or another interference had been deferred until late in labor. In a number of these specimens appropriate methods of staining enabled us to demonstrate the presence of streptococci in the tissues, but in others, such bacteriological evidence could not be adduced.

The fact that inflammatory changes were present in 40 per cent of our specimens is very impressive and serves to demonstrate anew the dangers of conservative Cæsarean section when performed at any other than the optimal time—namely, at an appointed date during the last days of pregnancy or within a few hours after the onset of labor in patients who have recently been examined only by those who observe an appropriate technique. In this group of cases, at least, I feel that the disadvantages incident to permanent sterilization have been more than compensated for by the increased saving of maternal life resulting from the radical operation.

Behavior of the Cicatrix after repeated Cæsarean Section.—In our series of specimens are included 10 uteri which had already been subjected to Cæsarean section upon one or more previous occasions, and it will be interesting to study the cicatrix in connection with the frequently made statement that it always constitutes a *locus minoris resistentiæ* and thus affords justification for the dictum—"Once a Cæsarean, always a Cæsarean."

In eight of the specimens, one of which had been subjected to two and another to three previous sections, it was difficult to find the old cicatrix by examination with the naked eye, and the only indication of its existence was afforded by the presence of slight vertical depressions upon the external and internal surfaces of the uterus. In these specimens microscopic examination revealed the entire absence of scar tissue in the uterine wall and showed that the muscle fibers extended across the site of the old incision as if it had never existed.

In other words, examination showed that, following the section, the uterine wall had been restored to its integrity, and that if offered little more chance for rupture than had a previous operation not been performed. It is interesting to note that in this series of cases the convalescence from the previous operation had been uneventful and uncomplicated, at least so far as the patients operated upon by us were concerned.

In another specimen, however, totally different conditions obtained. In this a deep furrow existed upon the external surface and a corresponding furrow upon the internal surface of the contracted amputated uterus, the two being separated by a band of tissue 3 mm. thick, which contrasted markedly with the adjacent uterine walls which measured 2.5 cm. in thickness. Under the microscope it was seen that the external furrow was covered by peritoneal epithelium, while the internal furrow was lined with typical decidua. The intervening muscularis, however, showed no sign of scar tissue, and differed

from the normal only by its extreme thinness. In this instance it is apparent that the healing following the previous operation had been defective, and that during the latter part of pregnancy the portion of the uterine wall corresponding to the cicatrix must have been of extreme tenuity and offered conditions very favorable for rupture, which fortunately had not occurred. The history of this patient shows that the convalescence from the first operation had been stormy, the abdominal incision had broken down and that she had just escaped with her life.

In the last specimen, actual rupture had occurred in the eighth month of pregnancy, the fœtus surrounded by the placenta and membranes having escaped into the abdominal cavity. The patient, however, exhibited no symptoms of shock, and made an uninterrupted recovery after removal of the uterus. Microscopical examination of the ruptured cicatrix showed that the placenta had been attached under it, and that the uterine walls were densely infiltrated with fœtal cells. It was impossible to determine the extent to which the site of the cicatrix had been thinned out before rupture, but it is permissible to believe that the thinning had been excessive, and that the scar was still further weakened by the invasion of fœtal cells and by the development of uterine sinuses, so that it had gradually yielded to the distention as term was approached. In this case, also, the recovery following the primary operation had been complicated.

The details concerning this series of cases will be published in full later, and I shall only say in this place that the evidence at our disposal indicates that the healing of Cæsarean section wounds is generally satisfactory, provided the convalescence has been normal, and ordinarily does not call for a repetition of the procedure unless definitely indicated by the existence of extreme disproportion or some other conditions. On the other hand, in patients in whom the convalescence has been abnormal, it is probable that the cicatrix will be greatly thinned out and will offer a *locus minoris resistentiæ*. In such cases, a repeated Cæsarean section may be indicated for the express purpose of avoiding a subsequent rupture. My experience, however, shows that this is not inevitable and that even should it occur, satisfactory results should follow prompt operation.

For practical purposes, therefore, I conclude that the behavior of the cicatrix can be regarded with equanimity provided the previous convalescence has been normal, but when it has been disturbed there is a reasonable probability of the occurrence of rupture, and that such patients should be kept under the closest observation during the last months of a succeeding pregnancy.

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FIG. 1.—Vertical mesial section through a full-term pregnant uterus; patient dying from eclampsia before onset of labor. × ½.

FIG. 6.—Vertical mesial section through uterus amputated immediately post partum. × ½.

Compare with Fig. 1, and note thick muscular walls, placenta *in situ*, obliteration of uterine cavity and festooning of fœtal membranes.

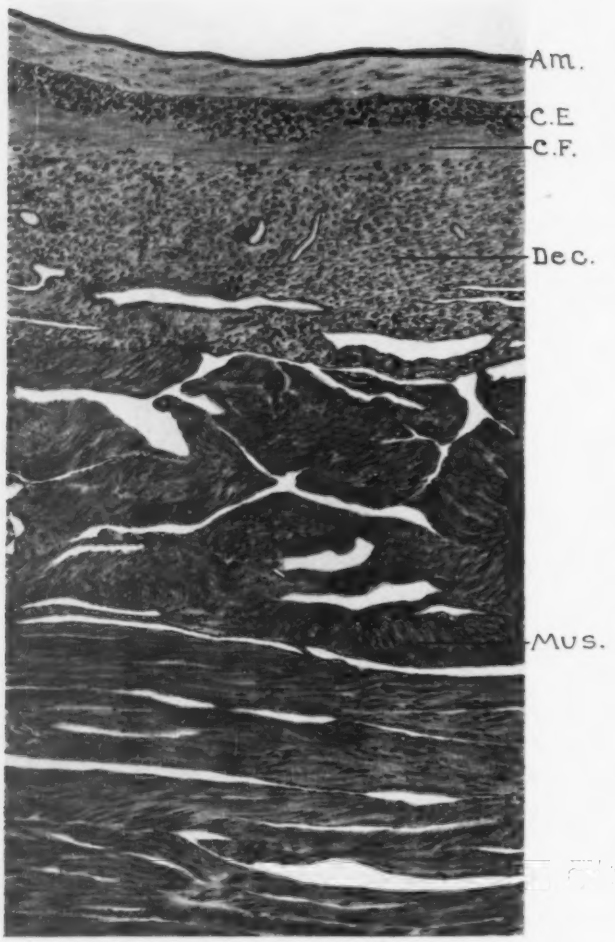

FIG. 2.—Section through uterine wall of full-term pregnant uterus outside of placental site, showing fœtal membranes, decidua and muscularis. × 65.
Am.—Amnion.
C. E.—Chorionic epithelium.
C. F.—Canalized fibrin.
Dec.—Fused decidua vera and capsularis.
Mus.—Muscularis.

FIG. 3.—Section through placental site before onset of labor, showing thin decidua basalis, with no spongy layer. × 65.
C. V.—Chorionic villi.
Dec.—Decidua basalis.
Mus.—Muscularis showing large venous sinuses.

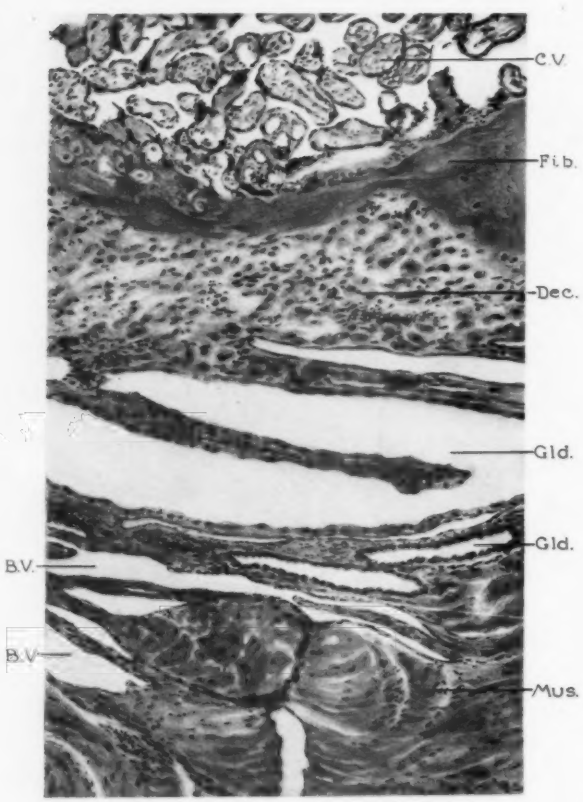

FIG. 4.—Section through placental site before onset of labor, showing thicker decidua basalis with a well-developed spongy layer. × 65.
B. V.—Venous sinuses in muscularis.
C. V.—Chorionic villi.
Dec.—Compact layer of decidua.
Fib.—Fibrinoid.
Gld.—Glandular or spongy layer of decidua.
Mus.—Muscularis.

FIG. 5.—Section through placental site before onset of labor, showing above fœtal aspect of placenta, below maternal aspect with thin decidua basalis and a trophoblastic septum, extending up into intervillous space. × 65.
Am.—Amnion and chorionic membrane.
C. E.—Chorionic epithelium.
C. F.—Canalized fibrin.
C. V.—Chorionic villi.
D. I.—Trophoblastic septum.
Mus.—Muscularis.

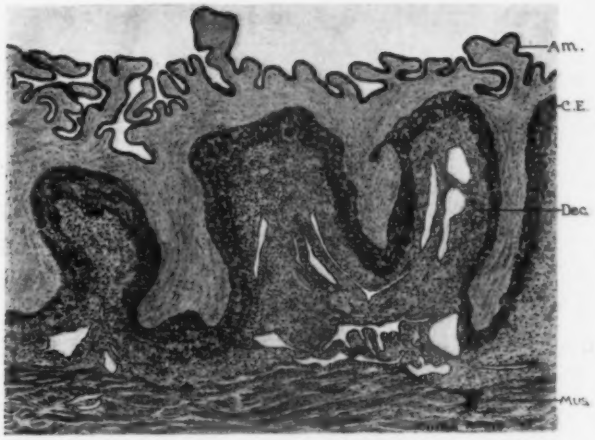

FIG. 7.—Section through wall of freshly delivered uterus outside of placental site, showing festooning of membranes. × 24.
Am.—Amnion.
C. E.—Chorionic epithelium.
Dec.—Decidua vera.
Mus.—Muscularis.

FIG. 8.—Portion of Fig. 7 more highly magnified. × 65.
Am.—Amnion.
C. E.—Chorionic epithelium.
Gld.—Gland spaces in decidua vera.
Mus.—Muscularis.

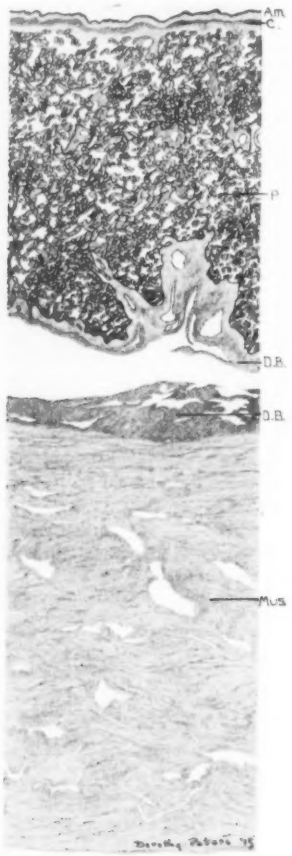

FIG. 9.—Diagram representing uterus with partially separated placenta. × 5.
Am.—Amnion.
C.—Chorionic membrane.
D. B.—Decidua basalis separated into two layers with balm onlays between them.
P.—Placenta.
Mus.—Muscularis.

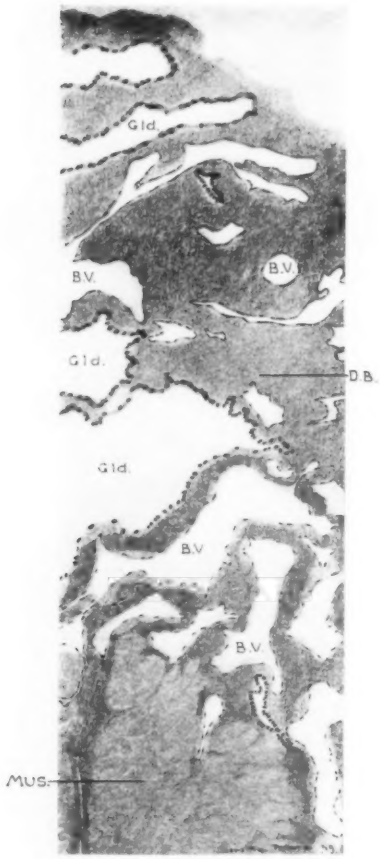

FIG. 12.—Diagram of another portion of the same placental site, represented in Fig. 11, showing retention of the greater part of the decidua basalis.

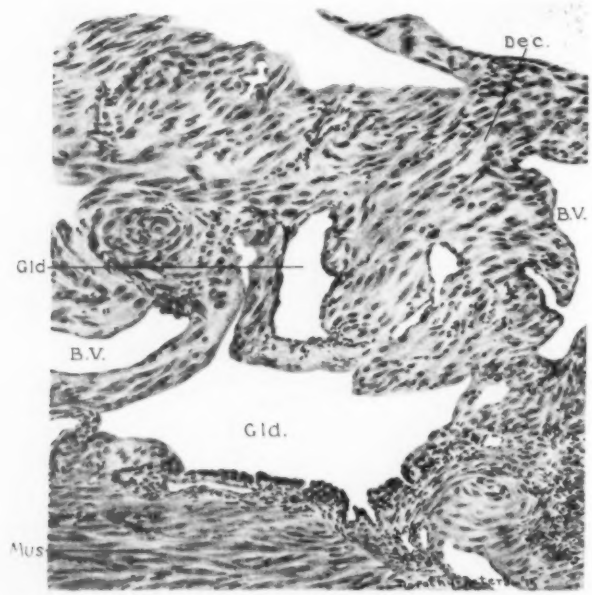

FIG. 10.—Section through freshly delivered uterus, showing that separation has occurred in the compact layer, leaving a portion of it as well as the entire spongy layer *in situ*. × 75.
B. V.—Blood vessel.
Dec.—Compact layer decidua.
Gld.—Gland spaces.
Mus.—Muscularis.

FIG. 11.—Diagram of placental site, showing retention of minimal amount of decidua basalis.
D. B.—Decidua basalis.
Mus.—Muscularis.

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ADENOMYOMA OF THE RECTO-VAGINAL SEPTUM.[1]

By THOMAS S. CULLEN, Baltimore, Md.

At the meeting of the Southern Surgical and Gynecological Association in 1913[2] I reported two cases of this character that had recently come under my care and also gave a short survey of the existing literature.

At the meeting of the American Medical Association in 1916 I discussed the subject more fully and reported three additional cases. For an extended survey of this interesting disease the reader is referred to the paper read on that occasion.[3]

Adenomyoma of the recto-vaginal septum is a diffuse growth consisting of non-striated muscle and fibrous tissue with large or small areas of mucosa identical with the mucosa of the body of the uterus scattered throughout it. This mucosa swells at the menstrual period and, as there is usually no escape for the blood, the gland spaces tend to become cystic and are filled with blood; or there is hemorrhage into the matrix of the tumor.

The tumor in the beginning is very small and starts in the vaginal vault just behind the cervix; or it may be recognized as a round or irregular thickening, not over 1 cm. in diameter, behind and usually attached to the cervix. The growth gradually spreads in a diffuse and irregular manner, involves the adjacent anterior rectal wall and spreads into one or both broad ligaments, until, finally, everything in the pelvis may be firmly glued into one mass.

In my paper of 1916 I made a tentative classification. This grouping may profitably be retained until our knowledge of the subject has been augmented. The classification with the number of cases brought up to date is as follows:[4]

1. Small adenomyomas lying relatively free in the recto-vaginal septum (Cullen's Case 1, Stevens' Case 1, Stevens' Case 5, Nadal's case, Cullen's Case 6).

2. Adenomyomas adherent to the posterior surface of the cervix and at the same time to the anterior surface of the rectum (Lockyer's Case 2, Cullen's Case 3, Stevens' Cases 2, 3, 4 and 6, Jessup's Cases 1 and 2).

3. Adenomyomas gluing the cervix and rectum together and spreading out into one or both broad ligaments (Cullen's Case 4, Cullen's and Richardson's Case 5, Kellogg's case,[5] Cullen's Cases 7, 8 and 9).

4. Adenomyomas involving the posterior surface of the cervix, the rectum and broad ligaments, and forming a dense pelvic mass that cannot be liberated (Cullen's Case 2).

Of course, one group merges imperceptibly into another, and a case which to-day belongs to Group 1 may in a few years belong to Group 2 or to Group 3.

Case 6 is one of the earliest adenomyomas on record and was diagnosed clinically. Case 7 is particularly interesting. The adenomyomatous growth was evidently a very active one, so active that it welled out into the vagina forming adenomyomatous polypi which projected into the vagina, and at some points areas of uterine mucosa lay in direct contact with the cavity of the vagina. It was from the histological examination of one of the vaginal polypi that the exact diagnosis was made. In this case, as will be noted from Fig. 3, both ureters were encircled and constricted by the adenomyomatous growth in the broad ligaments, so much so that above the point of involvement the ureters were greatly dilated, each being over 1 cm. in diameter. At the menstrual period with the swelling up of the uterine mucosa in the adenomyomatous areas the ureteral constriction was increased and the patient experienced pain in both renal regions.

In Case 8 the growth was very extensive, having involved the anterior and lateral rectal walls over an area about 9 cm. in length. The growth seemed to have developed within the space of two years. In this case also uterine mucosa projected directly into the vagina.

In Case 9 the growth has not yet been removed. The symptoms present were in large measure due to tuberculous pus tubes.

As can readily be inferred the symptoms will in large measure depend on the manner in which the growth extends. When small it occasions little trouble. Extension to the rectum may or may not be followed by pain. Implication of

[1] From the Gynecological Department of The Johns Hopkins Hospital and The Johns Hopkins University. Read before the American Gynecological Society, Pittsburgh, May, 1917.

[2] Thomas S. Cullen: Adenomyoma of the Recto-Vaginal Septum. Trans. Southern Surg. and Gyn. Assoc., 1913. Adenomyoma of the Recto-Vaginal Septum. Jour. Amer. Med. Assoc., March 14, 1914, p. 835.

[3] Thomas S. Cullen: Adenomyoma of the Recto-Vaginal Septum. Jour. Amer. Med. Assoc., Aug. 5, 1916, Vol. LXVII, p. 401.

[4] For an admirable review of the foreign literature on adenomyoma of the recto-vaginal septum consult Cuthbert Lockyer in Eden & Lockyer's New System of Gynecology, Vol. II, p. 350. It is brim-full of interest.

[5] Kellogg: Boston Med. and Surg. Jour., Jan. 4, 1917, p. 22.

the pelvic nerves in the diffuse growth may cause much neuralgic pain and encircling of the ureters by the growth may bring about unilateral or bilateral hydroureter with renal pressure symptoms at the periods.

Menstruation in some cases occasions much pain. If the mucosa of the growth has projected into the vagina, there will be an escape of menstrual blood from the posterior vaginal wall at the catamenial period, as was noted in Case 8 in which the patient menstruated, although her uterus had been removed two years before.

In those cases in which the glands of the adenomyoma extend through to the rectal mucosa there will naturally be some escape of menstrual blood from the bowel at the period—as in Case 8.

In all of the previous cases the tumor occurred during menstrual life. The four cases here recorded offer no exception to the rule. The patients were 28, 37, 27 and 43 years of age.

We know nothing as to the origin of these tumors, but it is certain that their glandular elements are identical with those of the mucosa of the body of the uterus. A careful survey of the wealth of embryological material in Professor Mall's laboratory may give us some clue as to the starting-point of these growths.

TREATMENT.

We have had no occasion to change the line of treatment suggested in the paper of 1916.

Some might argue that simple removal of the appendages would cause atrophy of the uterine mucosa contained in the adenomyomas of the recto-vaginal septum. My Case 2 is a sufficient answer. Although a supravaginal hysterectomy had been performed two years before for a myomatous uterus, the pelvic condition had grown steadily worse.

1. Where small discrete nodules exist in the posterior vaginal vault, these may be readily removed through a vaginal incision, as was so successfully done by Stevens.

2. Where the growth occupies the posterior surface of the cervix and extends laterally, the ureters should be dissected out carefully and a complete abdominal hysterectomy be performed.

3. If the growth be firmly adherent to the rectum, a wedge of the rectum should be removed, together with the uterus. It has been found best, after freeing the uterus on all sides, to open up the vagina anteriorly and laterally. The uterus and the rectum can then be lifted farther out of the pelvis, thus facilitating the removal of the necessary wedge of the anterior rectal wall. The uterus can be used as a handle, and the necessary rectal tissue and the uterus removed as one piece.

4. Where the lumen of the bowel is greatly narrowed, a complete segment of the rectum should be removed together with the uterus, and an anastomosis made.

5. In desperate cases, where everything in the pelvis is glued together, as in my Case 2, an ideal procedure is out of the question. The patient will not stand a long operation and, if she could, a satisfactory result could not be obtained. In such a case it would be better to cut across the sigmoid, invert the lower end, close it, and bring the upper end out through the abdominal wall of the left iliac fossa, making a permanent colostomy. When the patient has to some extent regained her strength, the uterus, the lower portion of the rectum and the broad ligament tissue can be shelled out as one piece.

These growths, while histologically not malignant, remind one of glue. Unless they are completely removed, further trouble is liable to occur.

Case 6 was simple and the woman made an excellent recovery.

In Case 7 the patient was too weak to allow us to resect the bowel and a portion of the growth still remains in the anterior recto-vaginal wall. Radium has been used, but the growth in the rectal wall is becoming thicker and sooner or later, I believe, it will be necessary to remove the portion of the rectum that is involved.

In Case 8 the operation had progressed so far that we were forced to resect the rectal growth. Had it not been for the wonderful assistance rendered by those helping at the operation, supplemented by the excellent post-operative nursing, this patient would certainly have succumbed. As it was, her life time and again was hanging in the balance. She will recover.

In Case 9 the adenomyoma still remains.

The occurrence of nine cases in the practice of one surgeon needs little comment. The disease is by no means rare. In the early stages it has naturally been overlooked. In the late stages it has been taken for an extensive and intractable inflammation in the vaginal vault or for a malignant growth involving the vagina and rectum.

CASE 6.—*A very early adenomyoma of the recto-vaginal septum associated with a polypoid condition of the endometrium which showed marked hyperplasia—early adenomyoma of the uterine wall.*

C. H. I., No. 15496.—Mrs. J. S., aged 43, was seen in consultation with Dr. Wilbur Pearce, on Sept. 19, 1916. This patient began menstruating at fifteen. The periods were always regular until her child was born 18 years ago. Since then she has suffered with pain in the right lower abdomen at the time of menstruation. The periods have been very irregular and the amount of pain has progressively increased, and has been especially marked during the last two or three years. The periods last from 5 to 15 days. There is often only an interval of from a few days to a week between periods. The pain has often been so severe that the patient has had to remain in bed for several days each month. She has had slight leucorrhœa.

On pelvic examination I found the uterus about half as large again as normal and just posterior to the cervix was a little puckered and thickened area apparently not over 1 cm. in diameter. I immediately suspected adenomyoma of the recto-vaginal septum.

Operation September 20.—We dilated and curetted, removing a moderate amount of tissue which in the frozen section showed hyperplasia. On account of the persistent bleeding and the fact that adenomyoma of the recto-vaginal septum existed, I decided to remove the uterus by the abdominal route. After dissecting free both ureters I did a complete hysterectomy, removing with the uterus the puckered area of peritoneum lying just posterior to the cervix (Fig. 1). This area of puckering was star-shaped.

A drain was laid from the pelvis into the vagina. The patient made an uninterrupted recovery and was allowed out of bed on the 15th day.

Gyn.-Path. No. 22483.—The uterus is 10 cm. long, 5 cm. broad and 4 cm. in its antero-posterior diameters. On the posterior surface of the uterus just on a level with the lower edge of the cervix is a puckered area 1 cm. in diameter. This at the time of operation was clearly visible and rather hard. The underlying tissue is slightly indurated and strongly suggests adenomyoma. The uterus itself apart from this is perfectly smooth. The appendages were not removed.

As mentioned above, just prior to the hysterectomy a dilatation and curettage had been done and the tissue, which was examined immediately, showed hyperplasia. On opening the uterus we found that, notwithstanding the curetting, the cavity was two-thirds filled with a rather polypoid, somewhat fibrous growth, which at the fundus reached 1.5 cm. in thickness.

Sections from the body of the uterus show that the uterine mucosa has an intact surface epithelium. The glands are large or small and have an epithelium that is thicker than usual. There is a definite tendency for the mucosa to extend into the underlying muscle, in other words, there is without doubt a beginning adenomyoma. The polypoid thickening consists of uterine mucosa. The glands here are large, tortuous and lined with thickened epithelium; the stroma is exceedingly cellular. One is able here and there to make out nuclear figures in the stroma. The picture is that of a typical hyperplasia of the endometrium. There is no evidence whatever of malignancy.

In this uterus, then, we have a definite hyperplasia of the endometrium with an unusually abundant polypoid formation of the mucosa. The uterine glands are also extending into the underlying muscle, producing an early adenomyoma.

The puckered area on the posterior surface of the uterus just at its junction with the cervix (Fig. 1)—the area that was recognized clinically—consists of myomatous tissue and glands (Fig. 2). These glands are tortuous, are lined with one or more layers of cylindrical epithelium and are in many places separated from the surrounding muscle by a stroma resembling in every particular that of the uterine mucosa. Some of the glands are dilated and we have a few miniature uterine cavities. All of the cavities and some of the glands show fresh hemorrhage. The picture present is that of a typical adenomyoma of the recto-vaginal septum. This is one of the few cases that we have been able to diagnose clinically before operation.

July 12, 1917.—About four weeks after returning home the patient lost bright red blood from the bowel. Near Christmas (1916) there was again bleeding, which continued for several days, the blood being bright red. In March, 1917 there was bleeding from the bowel for four days, and in the middle of April for four days. Bleeding started one week ago and has just stopped. She gives a history of having had bleeding from the bowel four years ago lasting for six weeks.

On proctoscopic examination the rectal mucosa looks perfectly normal and is nowhere thickened. The bleeding evidently comes from higher up in the bowel.

CASE 7.—*Advanced adenomyoma of the recto-vaginal septum constricting both ureters and causing double hydroureter. Extension of the adenomyoma into the vagina forming adenomyomatous polypi which hung down in the vaginal vault behind the cervix.*

For this most instructive case I am indebted to Dr. Myer Solis-Cohen of Philadelphia, her physician, and to Dr. Alfred Heineberg, the surgeon who saw her on numerous occasions and who removed several of the vaginal polypi. So far as I can learn, this case is unique.

Dr. Alfred Heineberg, in reporting this case in the *American Journal of Obstetrics* (March, 1917, p. 385), says: "The patient Miss —, aged 27, was referred to me by Dr. Myer Solis-Cohen of Philadelphia, on February 11, 1916, with the following history: About two years before she had been seized during her menstrual period with sudden severe pain in the rectum which radiated down the left thigh to the knee. This recurred with each succeeding period and was associated with menorrhagia until she was subjected to operation on Aug. 13, 1914. At this operation the uterus was dilated and curetted, and an abdominal incision was made. In the left ovary was found a cyst about the size of an orange, filled with old blood. There was a small quantity of similar bloody fluid free in the peritoneal cavity.

"Adhesions of the intestine to the pelvic structures required breaking up, and the left tube and ovary and appendix were removed. A rubber drainage-tube was inserted in the lower angle of the incision.

"For three months after operation she experienced slight relief in the symptoms, but by February, 1916, she was suffering severely and was again examined and two small polypi attached to the posterior vaginal wall were found. These were removed under gas anæsthesia but their removal afforded no relief.

"On July 23, 1915, several small polypi were again found in the same location. In addition to the menorrhagia she had noticed slight vaginal bleeding between periods. She refused further examination or operative treatment until Feb. 11, 1916, when I was requested to see her. On close questioning I learned that the rectal pain began on the fourth day of each menstrual period and persisted for several days after the cessation of the flow which was profuse and of 12 or 13 days' duration. On vaginal examination several small polypi were discovered attached to the posterior vaginal wall about 1 cm. below the vaginal portion of the cervix which was in no way connected with the tumor. They were soft like an ordinary mucous polyp of the uterus but somewhat more friable and bled from the slightest traumatism of the examination. The area of the vaginal wall to which the polypi were attached and the subjacent connective tissue were found indurated and thickened, imparting to the finger the sensation of a cellulitis of long standing. This indurated area was flattened and extended somewhat to each side into the base of the broad ligament. It could be more thoroughly outlined by a finger in the rectum and at the same time the mobility of the rectal mucous membrane over it was distinctly determined. The friability of the polypi, their tendency to bleed and their recurrence after the previous removal caused me to regard them as malignant. I was at a loss at first to account for either a benign or malignant polypoid growth in the posterior vaginal wall, because such growths are, as a rule, of glandular origin and the vaginal mucosa is usually devoid of glands.

"In order to avoid an unnecessarily extensive operation with the certain loss of the uterus in a young unmarried woman, I decided first to remove the polypi and subject them to histological study. If they proved to be malignant a subsequent abdominal operation would be imperative."

Dr. Heineberg removed these polypi under gas anæsthesia. They were pinkish in color. They were removed with the curette and the bleeding surface was cauterized with the actual cautery and the vagina tamponed. Heineberg says: "In spite of the precautions taken to produce hemostasis the patient suffered profuse bleeding from the vagina on the fifth and seventh days after the operation. The bleeding was again controlled by tampons. The patient left the hospital on the fourteenth day."

Dr. Heineberg did not examine the patient again until August 30, 1916. Dr. Myer Solis-Cohen had reported from time to time that there was no apparent change in her condition. At the examination on August 30, he found that the indurated mass in the recto-vaginal septum had increased somewhat in size since the previous operation and that it seemed to be attached to the supra-vaginal portion of the cervix. He discovered another small polyp about half the size of a pea at the site of the previous ones. This

he removed with the finger without difficulty He sent this polyp to me for histological examination.

My report was as follows:

"On histological examination some of the polypoid projections are found to be covered over by many layers of squamous epithelium similar to that noted in the vaginal vault. The surface of others consists of typical granulation tissue. In other words, there has been an ulceration of some of the polypi. The stroma immediately underlying the surface consists of rather dense connective tissue. Deeper down are large numbers of glands, some very large and surrounded by a characteristic stroma, others small and lying in direct contact with the surrounding connective tissue. Some of the larger glands are filled with blood. The glands are of the type found in the body of the uterus and the general gland picture is that we often note where glandular hyperplasia exists. At a few points the stroma cells are swollen and remind one considerably of the interlacing of large cells noted in an early sarcoma. I do not, however, think that this feature is of the slightest significance."

A few days later Dr. Heineberg sent me some more tissue from the vaginal vault. My findings were as follows:

"The polypoid mass that you sent me on September 20, 1916, has been marked Gyn.-Path. No. 22482. On the surface of this polyp I failed to find any evidence of vaginal mucosa. There is, however, a granulating surface and opening on the surface are typical uterine glands. This section brings out another interesting feature. Here and there throughout the stroma are yellowish-brown pigmented areas. At such points the stroma cells have taken up blood pigment, clearly showing that there have been old hemorrhages."

It was clearly evident that we were dealing with an adenomyoma of the recto-vaginal septum and I advised complete hysterectomy with, if possible, removal of the portion of the anterior rectal wall that had become involved in the growth.

Gyn. No. 22645.—The patient on admission to The Johns Hopkins Hospital, on November 16, 1916, was rather frail and somewhat anæmic. Her temperature was 99.2° F. and her pulse 88. On physical examination, however, it reached 120.

The patient said that she first developed symptoms of the present trouble in December, 1913, when she had pain during the last three days of the menstrual period. The discomfort was mild at first, but has gradually increased in severity. The pain is located in the rectum. At present it is very severe and she feels "as if the bowels must move." She has had no pain between periods and defecation does not cause discomfort, but digital examination of the rectum and enemata cause excruciating pain. There has been no bleeding from the bowel. The patient has slight dysuria and frequency of urination. During the last three days of the period there has also been a very marked desire to urinate frequently without the ability to do so.

Recently she has complained of severe pain in both renal regions during the period. A glance at Fig. 3 will clearly explain the cause.

The outlet was intact. The cervix rather fixed, firm and about normal in size. The body of the uterus was slightly enlarged, in good position, but its mobility was restricted.

Projecting from the vaginal vault posterior to the cervix were several polypi. (Fig. 4.) These were blunt or rather pointed. Some of them were dark blue or bluish black in color. The vaginal vault between the cervix and rectum was hard and thickened over an area about 3 cm. in breadth. On rectal examination the rectal mucosa was found intact, but the anterior rectal wall was hard and infiltrated and the cervix and anterior wall of the rectum would move as one piece.

Operation November 18, 1916.—When the abdomen was opened, there were found numerous omental adhesions to the anterior abdominal wall and also to the pelvic structures. These were released. It was also necessary to free several loops of small bowel that had become adherent in the pelvis.

The left round ligament was ligated and cut and the broad ligament opened. This enabled me to draw the uterus up a little. The right round ligament was now severed and the right broad ligament opened. On carrying the dissection down, the right ureter was found to be over 1 cm. in diameter. (Fig. 3.) The diffuse growth which involved the posterior wall of the cervix and the anterior rectal wall had extended out into the broad ligament and the ureter ran through this. The right ureter was gradually tunneled out of this tissue by stretching the tissue with a pair of long Kelly forceps. The uterine artery was doubly ligated and cut and the ureter exposed. Where it passed through the adenomyomatous tissue it was markedly constricted being not over one-half its normal size. Near the bladder, where it was free from compression, it was also somewhat dilated, being about 6 mm. in diameter.

The bladder was now separated from the cervix and pushed down.

The left ureter was much dilated being nearly as large as the right. It likewise was markedly constricted where it passed through the broad ligament. Here it lay completely encircled in adenomyomatous tissue. Near the bladder its calibre was slightly larger than normal. After doubly ligating and severing the left uterine artery and controlling all large vaginal veins, we freed the vagina for a distance of at least 3 cm. The uterus together with a cuff of vaginal mucosa nearly 3 cm. broad was removed. (Fig. 4.) We had hoped to remove the hardened area of the anterior rectal wall with the uterus but the patient's pulse was very weak, so we cut the cervix away from the rectum removing only the uterus with a large vaginal cuff and the right tube which was enveloped in adhesions. The right ovary was not removed.

An area of growth at least 3 x 2 cm. was left in the anterior rectal wall. After checking all oozing and whipping over the cut margins of the vagina, each ureter was lifted well up to the side of the pelvis so that it could not come in contact with the rectal growth. The broad ligaments were then closed and the raw surface of the rectum covered over as well as possible. Two drains were laid in the pelvis, their lower ends being brought out through the vagina.

The patient was discharged on Dec. 13, 1916, and at that time was entirely free from her previous discomfort. Hoping to diminish the size of the rectal growth or to at least check its progress I conferred with Dr. Curtis F. Burnam as to the use of radium. He has given her three applications and thinks that the rectal thickening is diminishing.

June 30, 1917.—I saw Miss Q., with Dr. Myer Solis-Cohen and Dr. Burnam. She looks remarkably well but when tired often has projectile vomiting. She also has rectal pain for five or six days at what should be the normal time for the period.

On vaginal examination the vault is found firmly closed, and but little thickening can be detected, but on rectal examination it is clearly evident that the growth in the anterior rectal wall has increased in thickness. One gets the impression that it is at least 1.5 cm. thick. Rectal examination occasions no bleeding and causes little pain.

July 24, 1917.—The patient says that she has had no pain in the kidney regions since operation.

Gyn.-Path. No. 23116.—The uterus is 10 cm. long, 5 cm. broad and 4 cm. in its antero-posterior diameters. Both anteriorly and posteriorly it is covered by adhesions. In the anterior surface of the fundus are two small myomata, the larger of the two being 9 mm. in diameter.

The cervix looks normal (Fig. 4). It is surrounded by a cuff of vaginal mucosa varying from one to two or more centimeters in breadth. The vaginal mucosa anterior to the cervix is unaltered, but behind the cervix polypi are seen springing from the mucosa.

These polypi are bluish-black in color, blunt or pointed, and project from 5 to 10 mm. from the surface of the mucosa.

When the uterus is cut lengthwise (Fig. 5) it is noted that the uterine walls as a whole present the usual appearance and that the mucosa of both cervix and body seems to be unaltered.

Commencing about 8 mm. behind the cervical canal and intimately blended with the cervical wall is a diffuse, striated growth, which reaches upward as far as the level of the internal os. It has dark patches and translucent areas scattered throughout it. The largest of the dark areas is 7 mm. long. The posterior surface of this growth was intimately blended with the rectum. It is from the lower surface of this growth that the polypi grew. In other words the polypi are portions of the growth which have projected into the vagina.

Histological Examination.—The character of the growth is particularly well shown in Fig. 6. The anterior wall of the cervix is normal and the mucosa lining the cervical canal presents the usual appearance. The greater part of the posterior wall of the cervix is markedly altered. It has a somewhat striated structure and scattered everywhere throughout it are quantities of typical uterine mucosa. This is recognized as islands of mucosa, as broad branching rivers of mucosa, or as miniature uterine cavities, as is well shown in Fig. 6 at *c*. The nearer one approaches the rectal attachment the more abundant is the uterine mucosa.

Not only is the posterior wall of the cervix involved in the growth but it has also extended to the vaginal wall. Islands of typical uterine mucosa are lying directly beneath the vaginal mucosa, or have broken through as shown in Fig. 6 at *b*, and in Fig. 11 between *c* and *c'*.

In Fig. 7 the character of the mucosa is clearly shown. The glands are tubular and are separated from one another and from the surrounding muscular and fibrous tissue by a definite stroma identical with that found in the mucosa lining the uterine cavity. In Fig. 8 we have a good example of a miniature uterine cavity, an area of typical uterine mucosa projecting into it. In Fig. 9 is a large mass of uterine mucosa projecting into and nearly filling a cervical gland. The cervical mucosa looks perfectly normal and is taking no part whatever in the growth.

The polypi projecting into the posterior vaginal wall are part and parcel of the adenomyomatous growth. The stroma of the polypi consists in large measure of fibrous tissue, and scattered throughout the stroma are glands of the type found normally in the mucosa from the body of the uterus (Fig. 10, Fig. 11, and Fig. 12). Some of the polypi are covered over by normal vaginal mucosa, but in others the growth has broken through the vaginal mucosa and polypi indistinguishable from those found in the uterine cavity are projecting directly from the vaginal vault (Fig. 11*a*).

The histological picture clearly shows that we have here an adenomyoma occupying the posterior wall of the cervix. This has extended by continuity to the rectum, and has infiltrated the posterior vaginal wall. The growth has been of such an exuberant character that it welled into the posterior vaginal vault, forming polypi, and in some places the growth has literally burst into the vagina, uterine mucosa projecting into and lining the vaginal vault.

CASE 8.—*Myomectomy, without interruption of pregnancy, in 1907. Supravaginal hysterectomy for myoma, in 1915. Removal of the cervix and several inches of rectum for adenomyoma of the recto-vaginal septum, in 1917.*

Mrs. L. D. K., aged 27, was referred to me by Dr. A. S. Mason, of Hagerstown, on August 5, 1907. She had had no children and no miscarriages. Her menses had begun at 12, had been regular and the flow moderate, the last period having occurred on May 28, 1907.

She was complaining of pain in the right ovarian region and two weeks before had noticed a lump there. During the last six weeks she had been complaining of morning sickness and the breasts had been slightly enlarged.

On abdominal examination I found a movable, slightly nodular mass, about 8 cm. in diameter, midway between the anterior superior spine and the umbilicus on the right. On vaginal examination the mucosa was found to be rather soft, the cervix was softened and the body of the uterus somewhat enlarged.

Operation.—We made a right rectus incision and found a subperitoneal pedunculated myoma, 8 cm. in diameter. This was attached by a pedicle 3 cm. broad and 0.5 cm. thick. The myoma was removed and the pedicle whipped over with catgut. The appendix was slightly enlarged but was not disturbed, as we were a little afraid of infection in face of the vascular myoma and the existence of pregnancy.

The patient went on to term and was delivered of a normal child who at the present time is perfectly well.

Two years ago (June, 1915) Dr. A. L. Stavely, of Washington, saw this patient and found it necessary to do a supravaginal hysterectomy for myoma. He found numerous adhesions, removed both tubes, the left ovary and the appendix. The patient was much improved. Her general health was better, she had no headaches and the bearing-down pains from which she had suffered were completely relieved for two months. She, however, had a good deal of constipation.

Menstruation following Hysterectomy.—Following operation although the uterus had been removed, the patient continued to have her menstrual periods. They came on regularly every month. They were slight in amount except on one occasion, when in January, 1917, although they were scanty, they continued for 28 days. The patient said that there had been a change in color of the menstrual flow for the last eight months. Before the hysterectomy and for about a year following the operation the menstrual blood had always been bright red, but during the last eight months it had been dark red and contained mucus. For the past year at times there had been intermenstrual bleeding varying in amount and frequency. This intermenstrual bleeding was sometimes noticed from the vagina, sometimes from the rectum and at times there had been more bleeding from the rectum than from the vagina. For the past year at least the patient had menstruated more frequently from the rectum than from the vagina. The dysmenorrhœa from which she had been suffering for some time was relieved for a short time after the operation but later had become increasingly severe.

The patient had been suffering from a marked constipation, intermittent in character. During the last few days of menstruation she has had severe constipation with aching pain on defecation. The constipation would last for two weeks at a time and then disappear as the menstrual period approached. During the period of constipation there would be dark blood in the stools. As soon as the period ceased, the constipation would develop again and continue for at least two weeks.

Dr. Stavely in a recent examination found a good deal of thickening in the vaginal vault behind the cervix and came to the conclusion that the patient was suffering from an adenomyoma of the recto-vaginal septum.

Gyn. No. 23289.—This patient was admitted to The Johns Hopkins Hospital on May 24, 1917. At the present time she is well nourished and looks perfectly well. She, however, complains of severe rectal and abdominal pain at the menstrual period.

Operation May 26, 1917.—I made a median abdominal incision and found the sigmoid flexure adherent to the posterior surface of the cervix. The adhesions were gradually loosened. We dissected out the left ureter in its pelvic portion and then the right ureter, after which the bladder was pushed down from the cervix. After large vaginal veins had been tied, the vagina was freed for a distance of several centimeters. We then opened up the anterior vaginal wall and gradually severed the posterior wall

of the vagina. As we were freeing the posterior vaginal wall there was an escape of an inky black fluid from the vagina just behind the cervix. Having completely separated the cervix with the vaginal cuff from the remaining portion of the vagina, we still found the cervix firmly glued to the rectum over a wide area. The patient's condition at that time was fairly good and I thought it might be possible to remove the anterior rectal wall without sacrificing the lateral and posterior walls, which would have simplified the operation materially. When we had done this, however, we found that there remained only a ribbon of the posterior rectal wall about 1.5 cm. broad; consequently we had to do a complete resection, removing about 12 cm. of the rectum. There was an escape of a good deal of liquid fecal matter. This, of course, could have been avoided had we at first attempted a complete resection of the segment of the bowel. The patient's condition now was precarious and it looked as if she would die on the table. We hurriedly stitched a rubber tube, about 1.5 cm. in diameter, into the upper cut end of the sigmoid and drew it down so that this part of the bowel passed into the lower segment. Two continuous rows of sutures completed the end-to-end anastamosis. A drain was laid in each broad ligament and brought out through the vagina. We also drained through the lower end of the abdominal incision. When the patient left the table she was practically pulseless. The operation in its entirety occupied nearly three hours.

July 12, 1917.—The patient had a stormy time for fully two and a half weeks following operation. For the first nine days all the urine was passed through the urethra, but on the 10th day it commenced to come through the vagina. The rectal tube came out on the seventh day and since then the major portion of the feces has escaped through the vagina. On the eighth day the patient developed a diarrhœa and had many stools each day. These stools were gradually checked. Since the fifteenth day there has been a gradual improvement and at the present time, July 12, the patient is able to be out of bed for several hours each day.

There is a hole 1.5 cm. in diameter in the anterior rectal wall at the site of the anastomosis.

October 16, 1917.—Patient's condition fair.

Gyn.-Path. No. 23074.—The specimen consists of the cervix and a segment of the rectum several inches in length. (Fig. 13.)

The vaginal portion of the cervix is 5 cm. broad, 3 cm. in its antero-posterior diameters; it projects for 1 cm. into the vagina. The cervical opening is slit-like and 1 cm. broad.

The cervix looks normal. It is surrounded by a vaginal cuff, averaging 1 cm. in breadth. Posteriorly where the cervix joins the vagina is a dark transverse slit 7 mm. long. It was from this point that the inky black blood escaped during the operation. At this point the growth has apparently broken through the vaginal mucosa.

It will be remembered that the body of the uterus was removed by Dr. A. L. Stavely two years ago on account of a myoma. The cervix is 5 cm. in length. On its right side near the peritoneal reflection is a bean-shaped myoma, 1.5 x 0.9 cm.

Occupying the posterior wall of the cervix and spreading out into the anterior and lateral rectal walls is a diffuse and very hard growth.

The portion of the rectal wall removed is 12.5 cm. long. Its anterior and lateral walls vary from 1 to 2 cm. in thickness, and are board-like, owing to the diffuse growth which occupies the cervix and adjacent rectal wall.

The anterior rectal wall is thickened over an area about 9 cm. in length, the greatest thickening being near the cervical attachment.

The mucosa of the anterior rectal wall is in some places stretched out and flattened over the growth. In other places it is gathered up into small polypi. The power of contractility of the anterior rectal wall has been reduced to the minimum.

At a point directly behind the cervix there is a dark hemorrhagic area 1 cm. in diameter in the rectal mucosa. Whether this has been caused during the operation or has been due to an extension of the growth through into the lumen of the bowel is uncertain. The mucosa from the posterior rectal wall looks normal.

On making a sagittal section through the specimen (Fig. 13) the anterior lip of the cervix is found to be little altered, save for one hemorrhagic spot, 2 x 2 mm., situated well above the vaginal attachment. The cervical mucosa looks normal except for a very small polyp projecting into the cervical canal.

The posterior wall of the cervix is markedly altered. It is occupied by a diffuse finely striated growth which extends almost from the cervical canal back to the thickened growth in the anterior rectal wall, with which it is continuous.

In the posterior wall of the cervix and separated from the outer surface of the cervix by a distance of 2 mm. is an irregularly pear-shaped cavity 1.5 cm. long and varying from 1 to 7 mm. in breadth. This is filled with very dark blood. At numerous points the growth contains small bluish black areas, and at the point where the slit was noticed behind the cervix and from which the inky black blood escaped during operation there is a bluish black area, 4 x 3 mm. This opens directly into the vagina. The nearer one approaches the rectal attachment the more abundant become the bluish black areas.

The growth has also extended to the posterior vaginal wall. This near the cervix is 1 cm. thick. In the posterior vaginal wall at a point at least 1 cm. from the cervix is a cavity, 3 mm. long, filled with blood. At the upper end of the cervical stump is a hemorrhagic area, 3 mm. in diameter.

From a careful examination of the gross specimen it is clearly evident that we are dealing with a growth that occupies the posterior wall of the cervix and that has extended to and involved the outer coats of the anterior and lateral rectal walls, and has also extended to the vaginal mucosa posterior to the cervix. The tumor bears the definite earmarks of an adenomyoma of the recto-vaginal septum.

Histological Examination.—A very large section (Fig. 14) has been made taking in the entire cervix and a portion of the recto-vaginal growth seen in Fig. 13. The mucosa of the anterior vaginal wall is normal. The squamous epithelium of the vaginal portion of the cervix has in many places been rubbed off, but where present is normal. The mucosa lining the cervical canal is perfectly normal, but lying in the cervical canal is a small polyp consisting of mucosa of the type found in the body of the uterus.

The large irregular cyst noted in the posterior wall of the cervix is lined with one layer of low cylindrical epithelium. In some places this lies directly on the underlying fibrous tissue, but at other points is separated from it by a definite stroma. The cavity of the gland is partly filled with blood.

The growth occupying the posterior wall of the cervix and the anterior wall of the rectum consists of typical adenomyomatous tissue. The stroma of the cervix passes over imperceptibly into that of the growth, there being absolutely no line of demarcation. Scattered everywhere throughout this growth are large and small areas of uterine mucosa consisting of normal-looking glands embedded in the characteristic stroma of the mucosa. Here and there the glands are markedly dilated and filled with blood. As one approaches the rectum the muscle in places seems to be arranged circularly around bunches of glands. At some points, as is particularly well seen in Fig. 15, islands of uterine mucosa extend directly to the rectal mucosa.

In the posterior wall of the vagina just behind the cervix is an island of uterine mucosa which has opened directly into the vagina. It was from this point that the inky blood escaped during the operation.

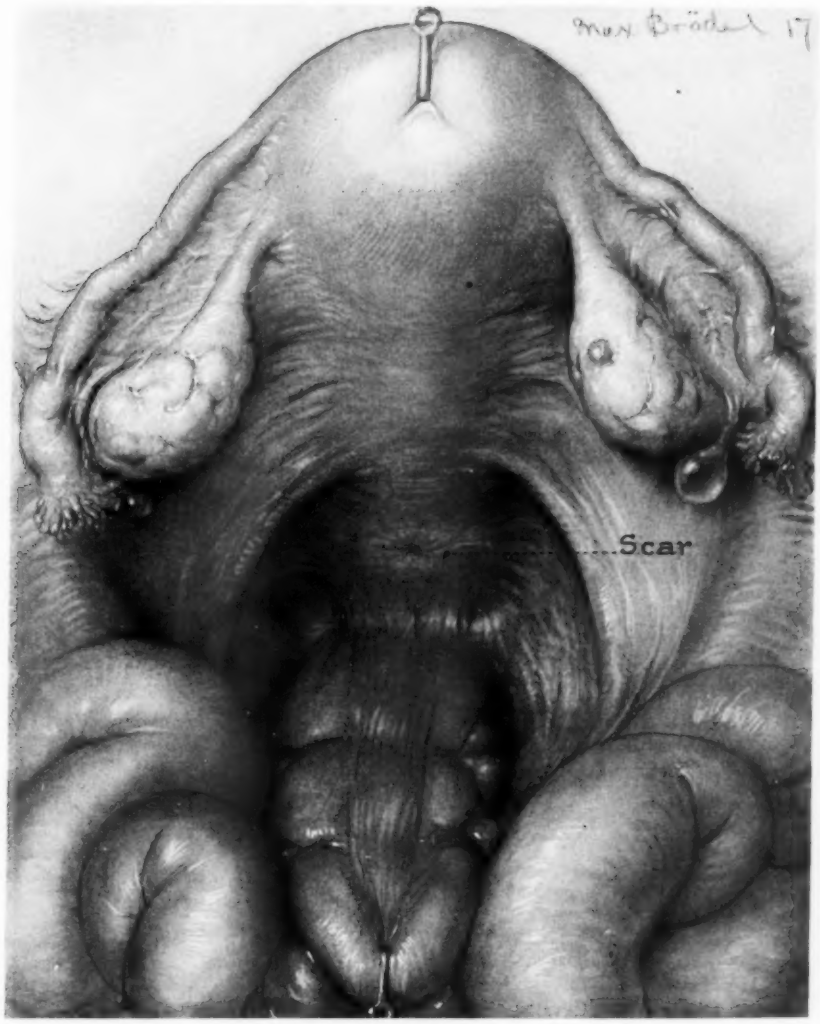

FIG. 1.—An early adenomyoma of the recto-vaginal septum. (Case VI.)
Gyn.-Path. No. 22483. On vaginal examination a small hard nodule could be felt in the vaginal vault just behind the cervix. On opening the abdomen we found in the mid-line just below and behind the cervix a puckered scar, about 1 cm. in diameter. As will be noted in the picture, this had a striated arrangement. The ureters were dissected free and a complete hysterectomy was done.
For the histological picture of the puckered area see Fig. 2.

FIG. 2.—Adenomyoma of the recto-vaginal septum. (Case VI.)
Gyn.-Path. No. 22483. This is a section from the puckered area noted on the anterior wall of Douglas' pouch just below the cervix and shown in Fig. 1. The matrix of the section is composed of non-striped muscle and fibrous tissue. Occupying the center of the field are uterine glands surrounded by the characteristic stroma of the uterine mucosa. In the left lower corner is a miniature uterine cavity.

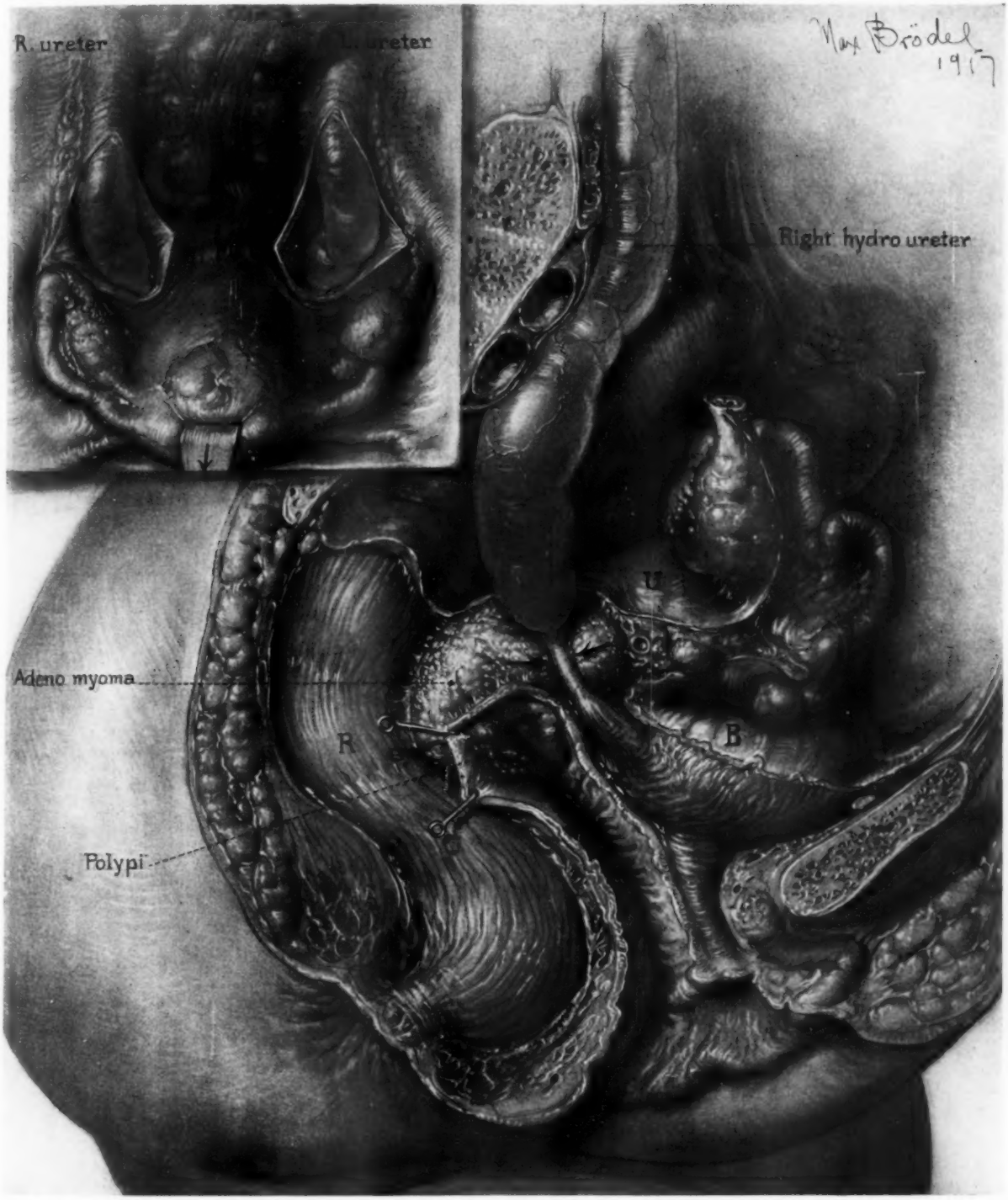

FIG. 3.—Dilatation of both ureters due to constriction by an adenomyoma of the recto-vaginal septum, which had extended out into the broad ligament on either side. (Case VII.)

In the left upper corner of the picture is shown the condition noted at operation. The rectum was firmly adherent to the posterior surface of the cervix. Both ureters were much dilated, being over 1 cm. in diameter.

The lower picture shows clearly the relation of the right ureter to the growth. The ureter is markedly dilated, but where it was encircled by the adenomyomatous tissue, as indicated by the arrows, it was greatly compressed, being not over 1.5 to 2 mm. in diameter. Near the bladder the ureter is slightly larger than normal.

The left ureter presented a precisely similar picture. At the menstrual period the adenomyomatous tissue evidently constricted the ureters still more, as is evidenced by the fact that during menstruation the patient had severe pain in both kidney regions.

The intimate blending of the growth occupying the posterior wall of the cervix with the anterior rectal wall is clearly seen. Behind the cervix the small polypi are seen projecting into the vagina.

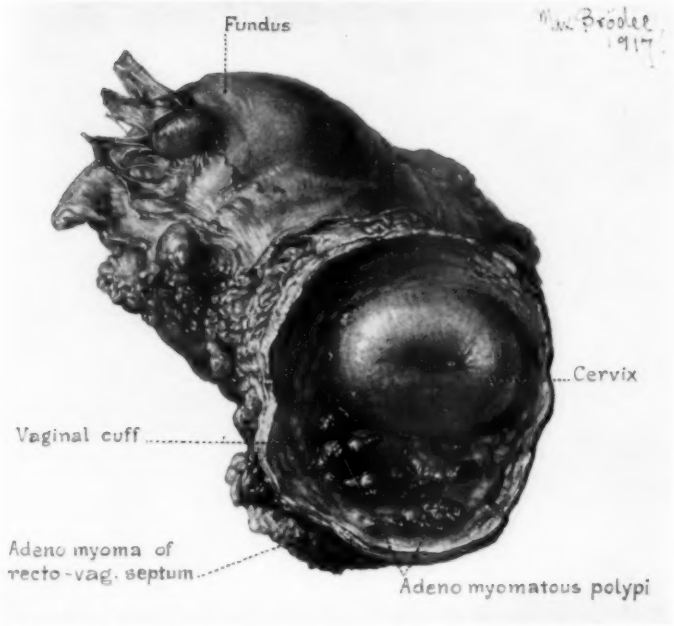

FIG. 4.—Adenomyoma of the recto-vaginal septum. Small adenomyomatous polypi projecting from the vaginal vault behind the cervix. (Case VII.)

Gyn.-Path. No. 23116. The uterus is little if at all enlarged. Springing from the side of the uterus are a few small myomatous nodules and attached to the surface are a few adhesions.

The vaginal portion of the cervix looks normal. Springing from the vaginal vault just posterior to the cervix are several polypi; some of these are blunt, others pointed. The majority of the polypi were bluish-black in color. These polypi were directly continuous with the adenomyomatous growth occupying the recto-vaginal septum. A portion of this recto-vaginal growth is seen. On account of the precarious condition of the patient time could not be taken to remove the rectal portion of the growth.

For the appearance of the growth on section see Fig. 5. For the histological picture consult Figs. 6, 7, 8, 9, 10, 11, 12.

FIG. 5.—Adenomyoma of the recto-vaginal septum with the formation of vaginal polypi. (Case VII.)

Gyn.-Path. No. 23116. This is a longitudinal section through the utĕrus shown in Fig. 4. Springing from the anterior surface of the uterus are a few small myomata and just above them are some adhesions. In the posterior wall of the fundus another small myoma is noted. The vaginal portion of the cervix, the mucosa lining the cervix and the cavity of the uterus are comparatively normal; the mucosa of the anterior vaginal wall is also unaltered.

Occupying a portion of the posterior wall of the cervix, the vaginal mucosa behind the cervix and extending to and involving the rectum is a diffuse striated growth. This contains dark, rather homogeneous areas. The growth also extends into the posterior vaginal vault forming blunt or pointed polypi.

For the low-power picture of the growth see Figs. 6, 10, 11. For the finer structures see Figs. 7, 8, 9.

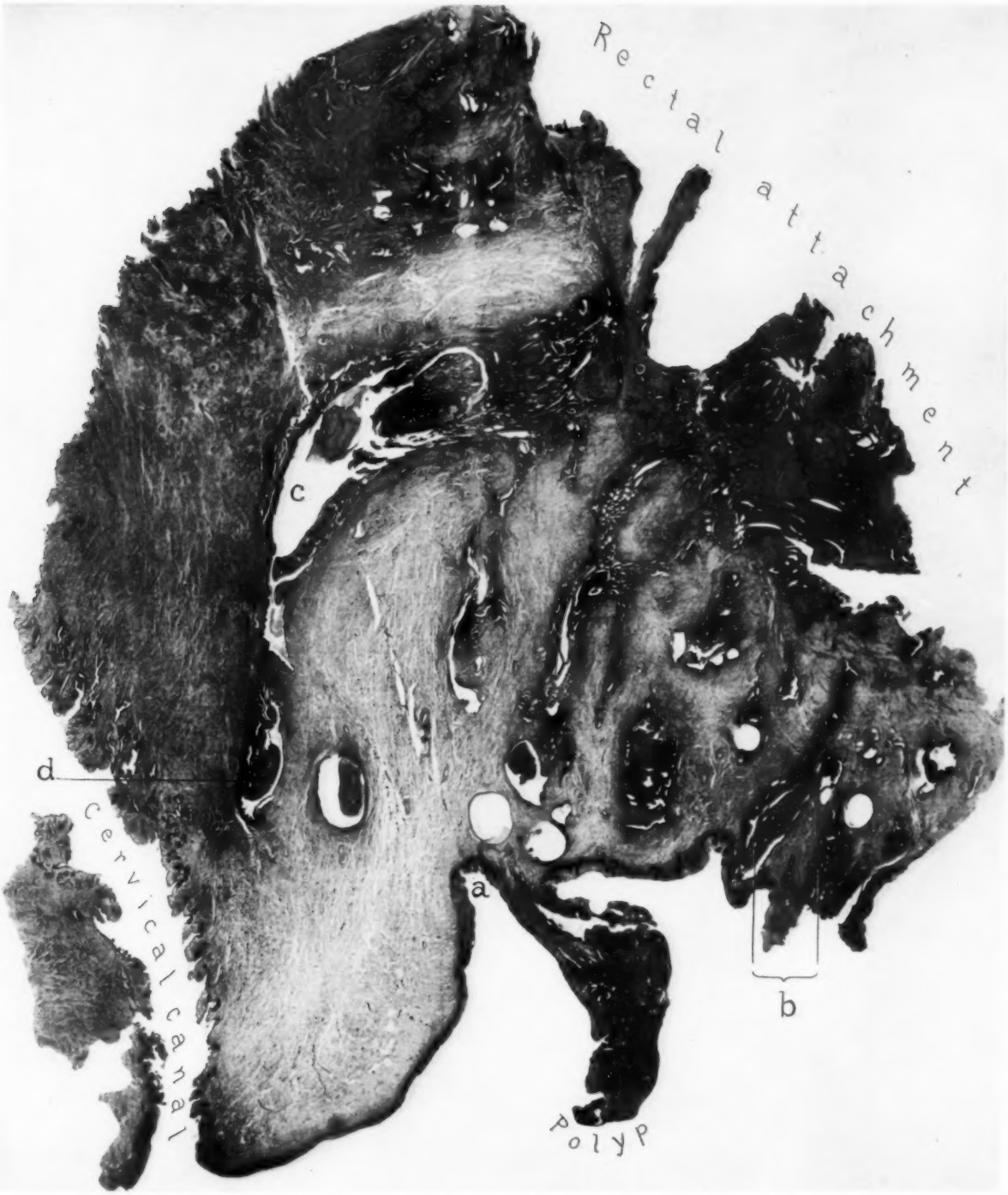

FIG. 6.—Adenomyoma of the recto-vaginal septum with the formation of vaginal polypi. (Case VII.)

Gyn.-Path. No. 23116. This is a low-power photomicrograph of the growth shown in Fig. 5. The section takes in a little of the mucosa of the anterior cervical wall and nearly all of that lining the posterior wall of the cervix. *a* represents the point where the cervix joins the vaginal mucosa.

The greater part of the picture consists of a striated growth with homogeneous areas scattered throughout it. Dotting these homogeneous areas are quantities of glands. Such areas consist of uterine mucosa identical with that normally found lining the cavity of the uterus. The nearer we approach the rectal attachment the more abundant are these islands or rivers of uterine mucosa.

At *a* a polyp is seen projecting into the vagina. This under the high power is seen to be covered over with vaginal mucous membrane, but scattered throughout its stroma are uterine glands.

At *b* the uterine mucosa has broken through into the vagina, the vagina at this point being lined with endometrium indistinguishable from that normally lining the cavity of the uterus.

At *c* is a miniature uterine cavity; at *d* a cervical gland is being distended by an area of normal endometrium. An enlargement of this area is shown in Fig. 9.

The rectal portion of the growth could not be removed on account of the precarious condition of the patient.

FIG. 7.—Adenomyoma of the recto-vaginal septum. (Case VII.)
Gyn.-Path. No. 23116. This is a higher magnification of some of the glandular areas seen in Fig. 6. From the left upper and right lower corners we get a fairly good idea of the stroma of the growth which consists of non-striated muscle and fibrous tissue.
Occupying the central portion of the picture are tubular glands lined with one layer of cylindrical epithelium and embedded in a stroma identical with that normally found in the mucosa lining the uterine cavity.

FIG. 8.—A miniature uterine cavity in an adenomyoma of the recto-vaginal septum. (Case VII.)

Gyn.-Path. No. 23116. Occupying the center of the picture is an area of typical uterine mucosa. It shows one layer of cylindrical epithelium and contains round or irregular glands lined with one layer of cylindrical epithelium. The glands lie embedded in an abundant and characteristic stroma.

This area drains into a miniature uterine cavity which contains exfoliated epithelium, leucocytes and shadows of red blood corpuscles, the remnants of old menstrual blood.

Surrounding this miniature uterine cavity with its adjacent mucosa is non-striated muscle.

FIG. 9.—Adenomyoma of the recto-vaginal septum, an area of endometrium projecting into and distending a cervical gland. (Case VII.)

Gyn.-Path. No. 23116. This is an enlargement of the area *d* in Fig. 6.

Occupying the center of the field is an area of relatively normal endometrium, which is projecting into a cervical gland. The characteristic and very high cylindrical cells of the cervical gland are clearly seen at *a*. The cervical epithelium is playing no rôle in the development of the adenomyoma. Surrounding the mucosa is non-striated muscle and fibrous tissue.

FIG. 10.—An adenomyomatous polyp projecting into the vagina. (Case VII.)

Gyn.-Path. No. 23116. The photomicrograph shows a portion of the posterior vaginal wall that was involved in the adenomyoma of the recto-vaginal septum. Scattered throughout the field are numerous areas of typical uterine mucosa and at *a* is a very large area of mucosa with a miniature uterine cavity.

The vaginal polyp which is one of those shown in Fig. 4 contains numerous glands. Its surface is covered with normal vaginal mucosa.

For the appearance of other vaginal polypi see Figs. 6, 11, 12.

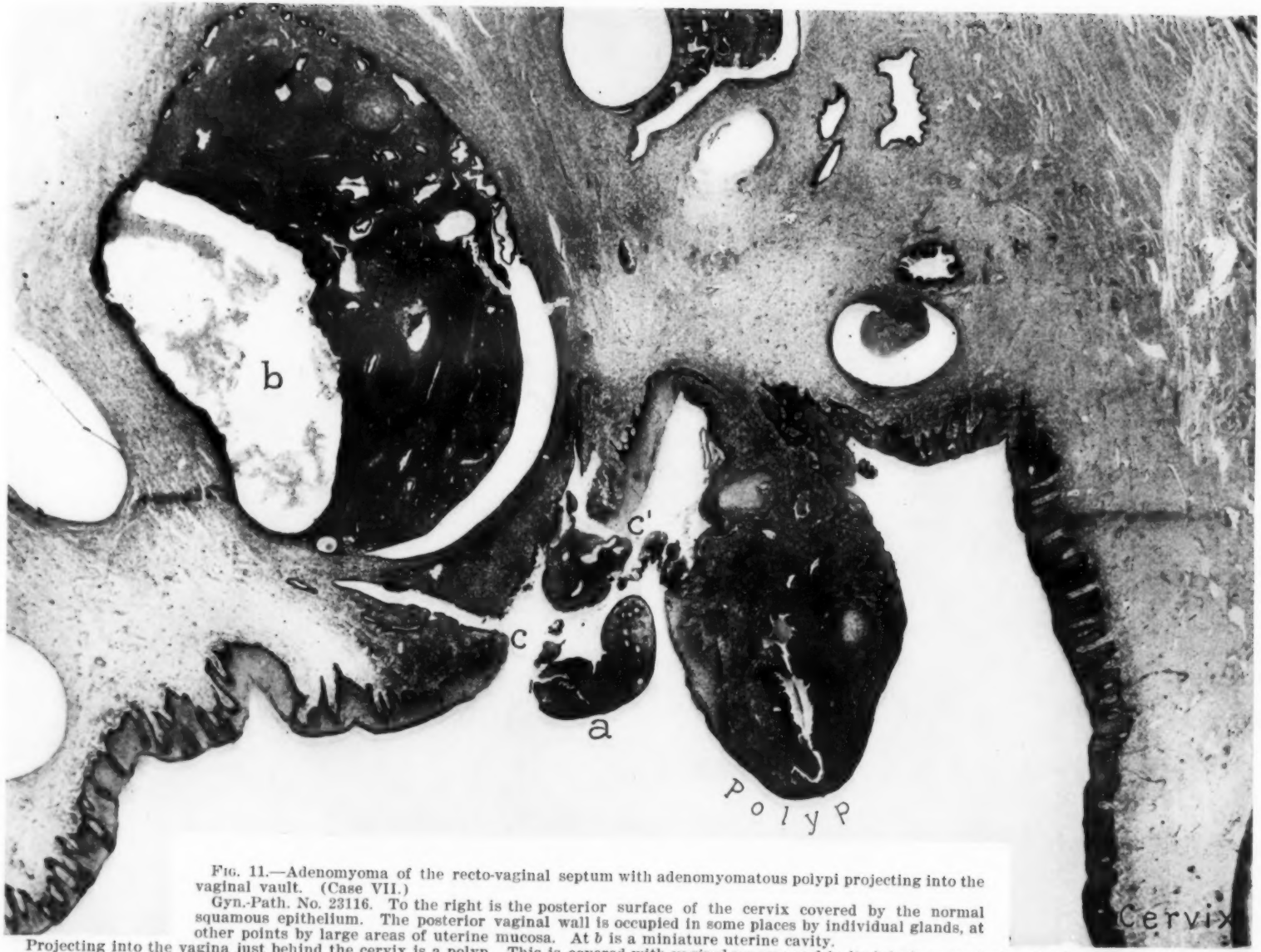

FIG. 11.—Adenomyoma of the recto-vaginal septum with adenomyomatous polypi projecting into the vaginal vault. (Case VII.)

Gyn.-Path. No. 23116. To the right is the posterior surface of the cervix covered by the normal squamous epithelium. The posterior vaginal wall is occupied in some places by individual glands, at other points by large areas of uterine mucosa. At *b* is a miniature uterine cavity.

Projecting into the vagina just behind the cervix is a polyp. This is covered with vaginal mucosa and in its interior are uterine glands.

Between *c* and *c'* the vaginal mucosa has been broken through and the uterine mucosa lines the vagina. Here also we have the uterine polyp *a*, which has an outer covering of one layer of cylindrical epithelium. Its interior consists of uterine glands embedded in their characteristic stroma. Menstrual blood undoubtedly escaped from this area at the period.

FIG. 12.—An adenomyomatous polyp projecting into the vagina. (Case VII.)
Gyn.-Path. No. 23116. This is the base of one of the polypi seen in Fig. 6. The distance between *a* and *a* indicates the pedicle of the polyp and the arrows show the manner in which the polyp had spread out toward its tip.
The vaginal mucosa is carried out over the surface of the polyp.
The stroma of the polyp consists chiefly of fibrous tissue. There appears to be a small amount of non-striated muscle. Passing into the polyp from the underlying vaginal tissue are uterine glands.

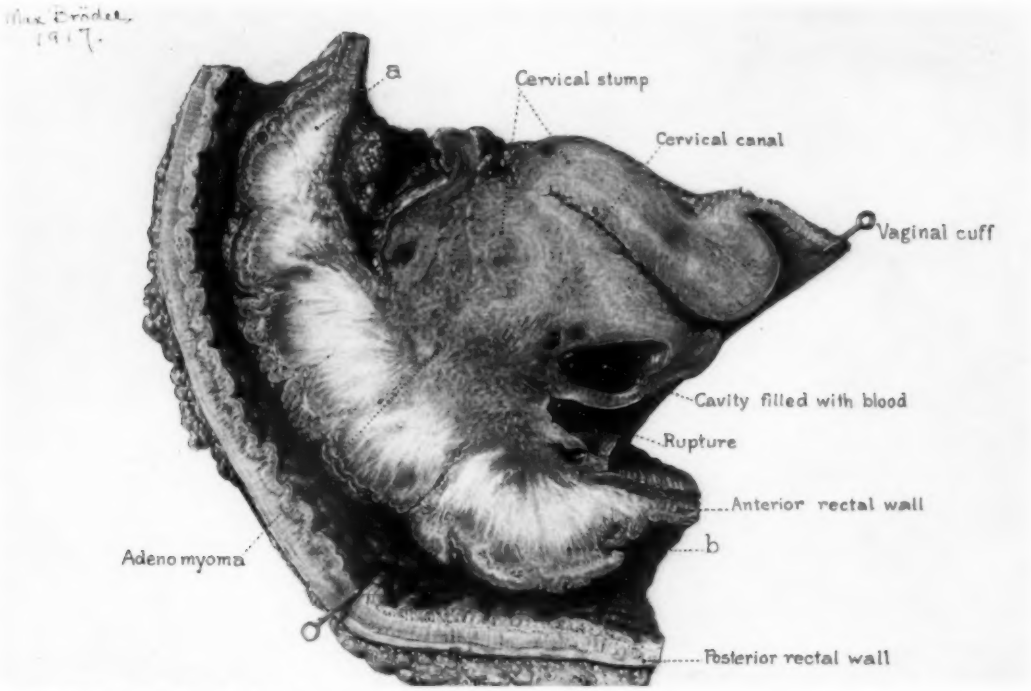

FIG. 13.—Adenomyoma of the recto-vaginal septum. (Case VIII.)

Gyn.-Path. No. 23074. The body of the uterus was removed for myoma two years ago. The specimen consists of the cervical stump and a greatly thickened segment of the adjacent rectum. The anterior vaginal wall is normal. The anterior lip of the cervix is unaltered and the cervical canal presents the usual picture.

In the posterior lip of the cervix is an irregular oval cystic cavity filled with blood. It was lined with one layer of low cylindrical epithelium which in some places rested on the stroma of the cervix. At other points, however, the epithelium rested on a very cellular stroma similar to that in the body of the uterus.

The posterior portion of the cervix has a coarse striated appearance and scattered throughout it are small, dark, cystic spaces. The cervical growth passes over imperceptibly into the greatly thickened anterior rectal wall. The rectal wall also presents a striated fibrous appearance particularly well seen at *b*. It is greatly thickened, in some places being nearly 2 cm. thick. The mucosa of the anterior rectal wall is intact, but here and there is gathered up into small polypi. The growth has also involved the lateral rectal walls. The posterior wall of the rectum is normal.

In the vaginal vault just behind the cervix a small cystic space opens directly into the vagina. It was from this point that the inky black blood escaped during the operation.

For the low-power picture of the cervix see Fig. 14; for the character of the rectal portion of the adenomyoma consult Fig. 15.

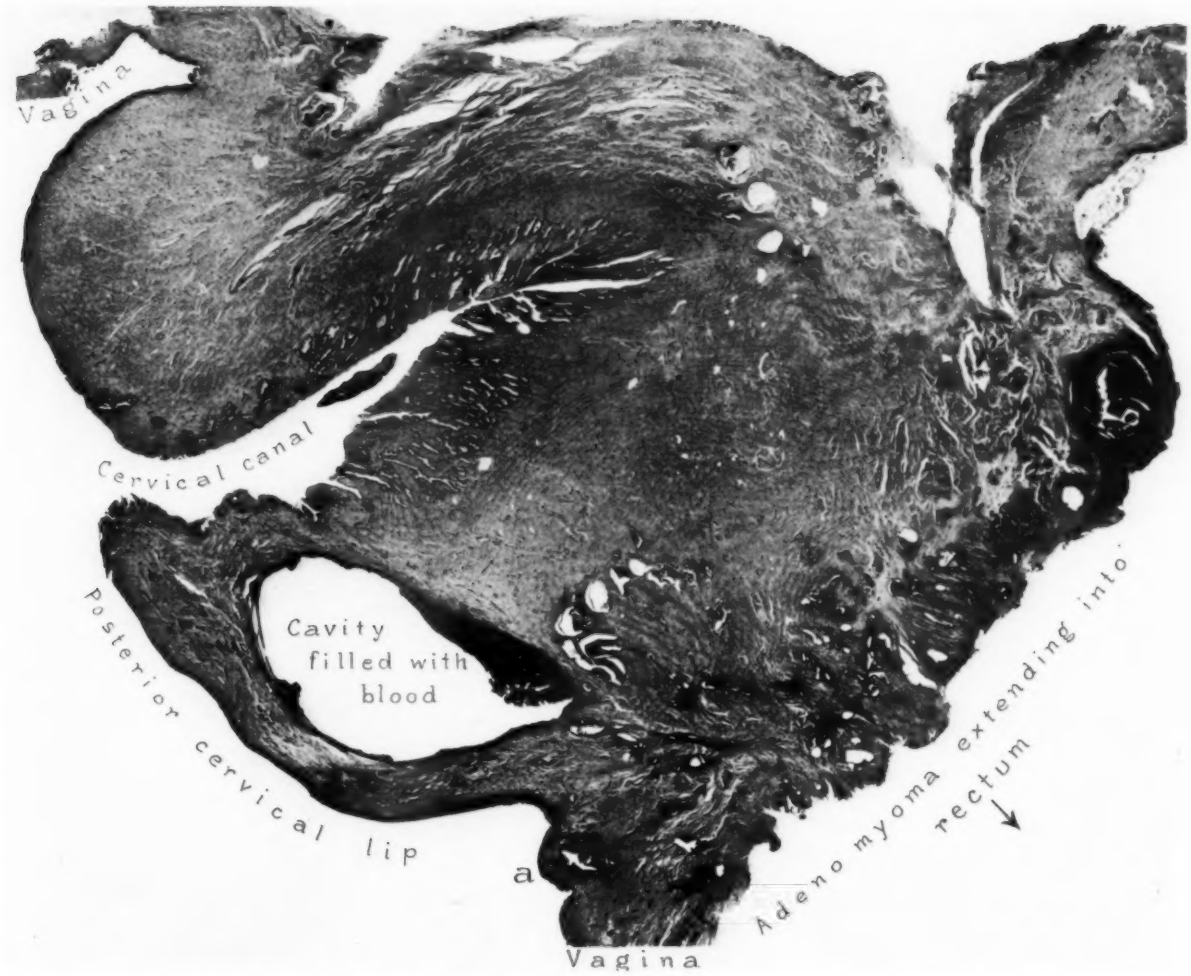

FIG. 14.—Adenomyoma of the recto-vaginal septum. (Case VIII.)

Gyn.-Path. No. 23074. This is a photomicrograph of the cervix—the body of the uterus had been removed two years before. The anterior wall of the cervix is normal. The mucosa lining the cervical canal presents the usual appearance, but lying in the canal is a longitudinal section of a small polyp.

The large cavity in the posterior wall of the cervix and noted in Fig. 13 was lined with cylindrical epithlium and was filled with blood.

Occupying the posterior part of the cervix is an adenomyomatous growth. It will be noted that the majority of the glands are embedded in a stroma; some of them are dilated.

It was at a point near *a* that the uterine mucosa had broken through into the vagina. From this point the inky black blood escaped during operation.

The widespread adenomyoma occupying the posterior part of the cervix was directly continuous with that involving the anterior and lateral rectal walls as indicated in Fig. 13. For the rectal involvement see Fig. 15.

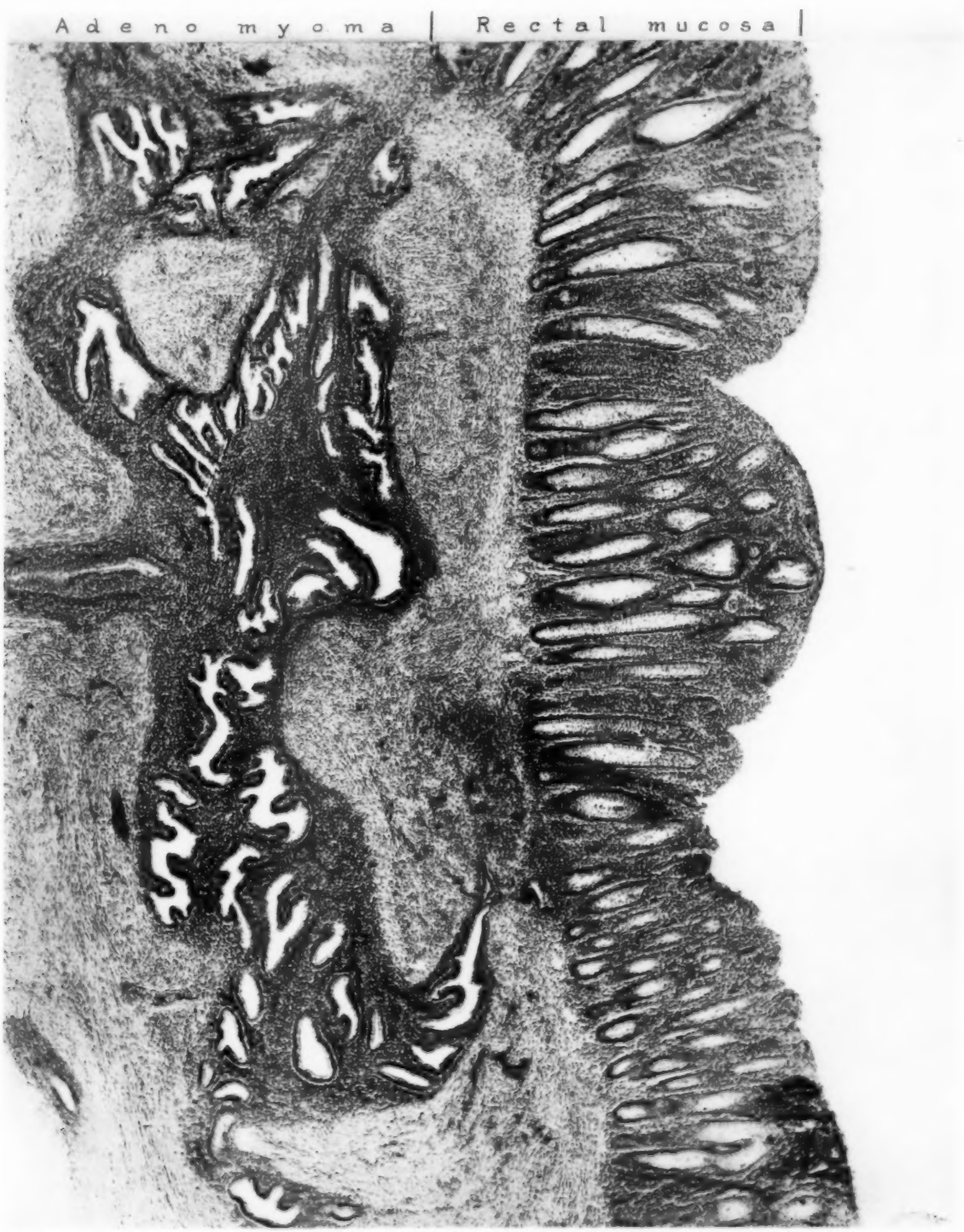

FIG. 15.—Adenomyoma of the recto-vaginal septum encroaching on the rectal mucosa. (Case VIII.)
Gyn. Path. No. 23074. For the gross appearance of the specimen see Fig. 13.
This is a photomicrograph of a section from the anterior rectal wall. The rectal mucosa is normal, but immediately beneath it there is a diffuse myomatous thickening of the tissue and large quantities of normal-appearing uterine mucosa have invaded the rectal wall extending at one point almost to the rectal mucosa.

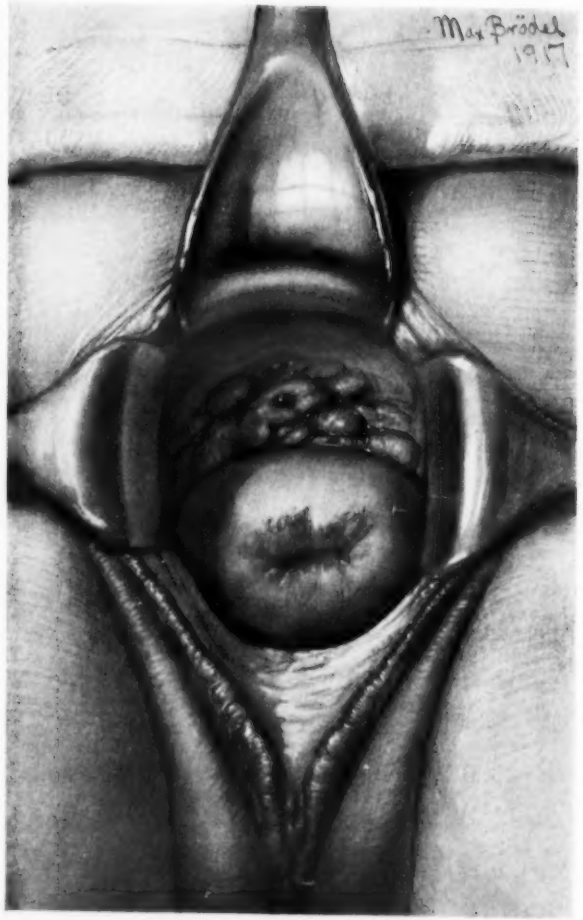

FIG. 16.—Sessile polypi in the posterior vaginal vault due to adenomyoma of the recto-vaginal septum. (Case IX.)

Gyn. No. 22989. The patient is in the knee-chest posture. The cervix is normal. The vaginal vault just behind the cervix presents a roughened, uneven appearance due to broad-based sessile polypi. These are smooth and are covered over with vaginal mucosa. At several points there were small, brownish cystic areas in the polypi, evidently due to old menstrual blood that had accumulated in the substance of the polypi.

The growth extended through to and involved the anterior rectal wall (see Fig. 17).

Later on we expect to remove the uterus, posterior vaginal vault and the involved area of the anterior rectal wall.

No histological examination of the tumor has as yet been made, but the diagnosis is perfectly clear.

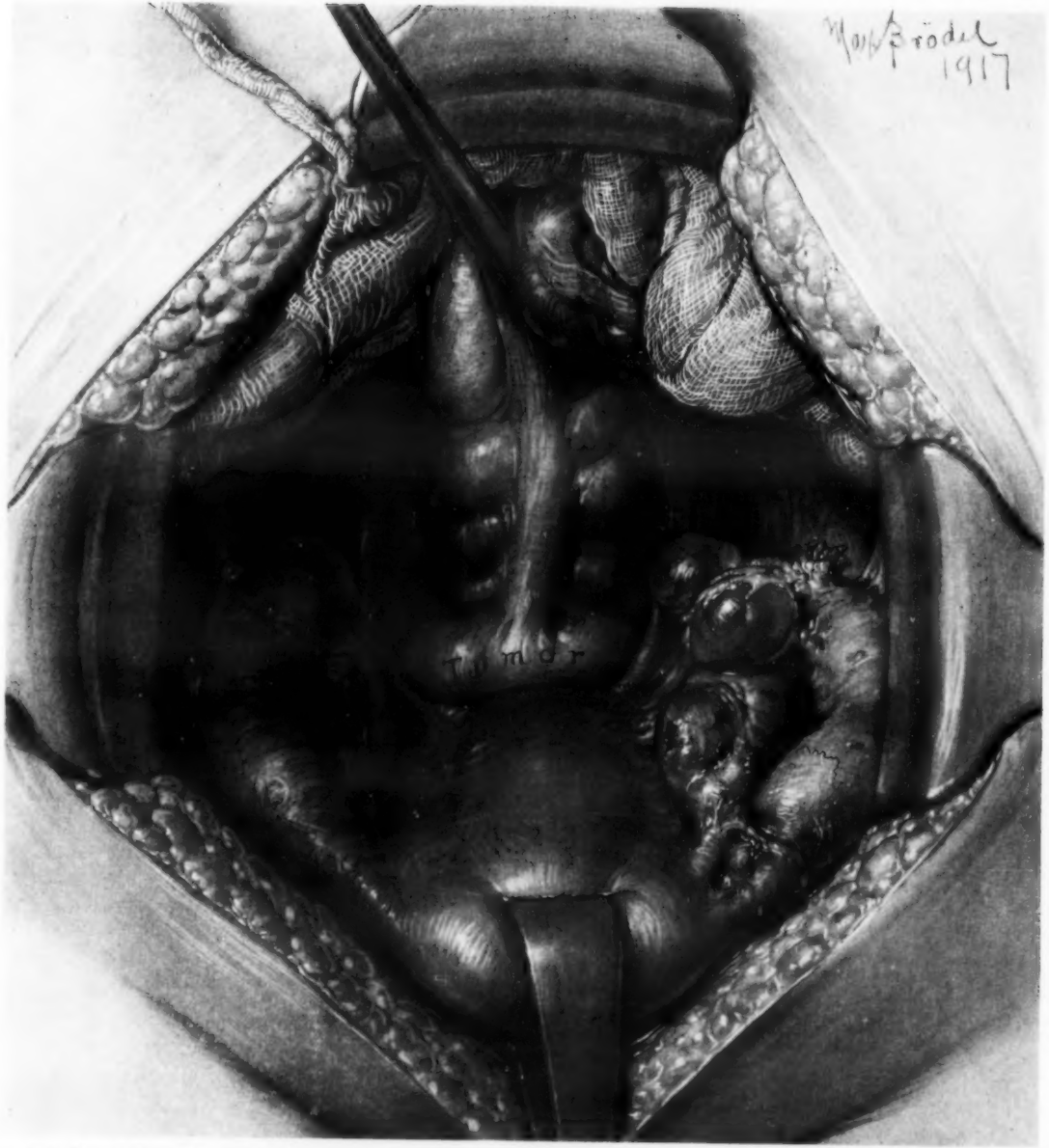

FIG. 17.—Adenomyoma of the recto-vaginal septum with the formation of sessile polypi in the vaginal vault; double pus tubes. (Case IX.)

Gyn. No. 22989. Both tubes are the seat of a pyosalpinx. Their fimbriated ends are slightly open, suggesting tuberculosis (histological examination shows that they are tuberculous). Near the fimbriated end of the right tube are two small cysts. The ovaries are embedded in adhesions.

At a level of the internal os is a hard tumor, about 2.5 cm. broad. This involves the posterior surface of the cervix and the anterior surface of the rectum. For its appearance in the vaginal vault see Fig. 16.

We have in this case had the opportunity of examining the patient from time to time during the last ten years. Ten years ago a subperitoneal myoma was removed during pregnancy; two years ago Dr. Stavely did a supravaginal hysterectomy for myoma. At that time there was no evidence of an adenomyoma of the recto-vaginal septum nor were there any clinical manifestations of such a condition except pain on defecation. No thickening could be detected, consequently we must conclude that this widespread growth has developed in large measure or entirely during the last two years.

CASE 9.—*Adenomyoma of the recto-vaginal septum with the formation of polypi in the vaginal vault; double pus tubes (tuberculous).*

Gyn. No. 22989.—M. W., aged 28, married, was admitted to The Johns Hopkins Hospital on April 17, 1917. The patient is a well-nourished colored woman. She complains of pain in the lower abdomen.

Her menses began at eleven, were regular, lasted three days, were free and painless. For the last four or five years, however, she has had some pain at the period. She menstruated on February 25, and since then has had slight bleeding from time to time, lasting, however, only a few hours. She missed her period in March but for the last two days has been bleeding constantly and rather profusely.

During February urination was frequent and painful and she had to void two or three times each night. At present there is no discomfort on micturition. Recently she has had a good deal of tenderness in the right lower abdomen. Her leucocyte count is 7000; her hæmoglobin 52 per cent.

She has been married eight years but has never been pregnant.

The outlet is moderately relaxed. Bartholin's glands are not felt and there is no urethral reddening. The cervix is normal in size. Its mobility is somewhat restricted and manipulation of the cervix causes pain.

There is marked induration in the vaginal vault behind the cervix, and on exposing the vagina we see the condition shown in Fig. 16. The posterior vaginal vault presents an uneven and puckered appearance due to numerous rather flat, smooth, sessile polypi. These are everywhere covered over by vaginal mucosa but some of them are slightly cystic, and in the depth of a few a definite brownish color is clearly demonstrable making the diagnosis of adenomyoma certain. There is a considerable amount of induration in both vaginal fornices.

On rectal examination a bar of indurated tissue, at least 2 cm. in width, is felt between the rectum and cervix. The rectal mucosa itself is intact and smooth, but small, hard, shot-like masses can be felt in the rectal wall above the growth. These are not larger than split peas. Proctoscopic examination reveals a normal-looking mucosa.

Operation, April 23, 1917.—On opening the abdomen I found the picture shown in Fig. 17. Each tube was the seat of a pyosalpinx, but the fimbriated ends of both tubes were slightly open, strongly suggesting tuberculosis. We thought it wiser to remove the tubes before removing the uterus thus reducing to the minimum the chances of infection. The ovaries were also removed, in the first place because they were densely adherent, in the second place because if any portion of the adenomyoma were left behind the presence of the ovaries would tend to stimulate the further extension of the portions of the tumor that it had not been possible to remove.

After removal of the appendages we carefully examined the uterus and rectum. In the posterior wall of the uterus was a subserous myoma 1 cm. in diameter. Behind the cervix at the level of the internal os was a hard indurated mass, 2.5 cm. in diameter. This involved the posterior wall of the cervix and the anterior wall of the rectum (Fig. 17). The bowel wall and the uterine wall at this point were intimately blended together. It was perfectly clear that we were dealing with an adenomyoma of the recto-vaginal septum.

The patient's pulse was very rapid before the operation was started and by the time the tubes and ovaries had been removed was varying from 160 to 170; consequently it was deemed safer to defer the hysterectomy until a later date. A pulse of from 140 to 160 is frequently encountered during an operation for pus tubes and as a rule occasions no alarm, but the patient could not have withstood the widespread dissection and the hysterectomy that would have been necessary.

She had a stormy time for the first three days, but then improved rapidly. She was discharged on May 6 with instructions to return several months later for removal of the recto-vaginal growth.

This growth on histological examination will undoubtedly show the typical adenomyomatous picture. Its situation is characteristic and the picture as seen in Douglas' cul-de-sac further substantiates the diagnosis. The development of the flat polypoid condition in the vaginal vault is also confirmatory, and the brownish hue due to the accumulation of old menstrual blood in the polypi leaves no doubt as to the presence of adenomyoma. As was noted the rectal mucosa itself was normal.

Gyn.-Path. No. 23170.—Sections from the Fallopian tubes show typical tuberculosis.

It is a pleasure to acknowledge my obligation to three of my friends who have added greatly to the value of this article. Mr. Max Brödel, the Director of the Department of Art in Medicine in The Johns Hopkins Medical School made the drawings which so faithfully portray the conditions found. Dr. Benj. O. McCleary took infinite pains in the making of very large sections which included the cervix and a portion of the rectum in one piece. Mr. Herman Schapiro has furnished us with photomicrographs which it would be almost impossible to excel.

HEMATOMATA OF THE OVARY, INCLUDING CORPUS LUTEUM CYSTS.*

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There is no organ in the body which is so frequently the seat of hemorrhages as is the ovary. Indeed, so common are they that no clinical significance is attached to the small hematomata so frequently found in the ovaries removed at operation. In the case of large blood tumors, the clinical picture is essentially that which characterizes other benign ovarian neoplasms.

That even small hematomata are not altogether without important clinical potentialities is shown by the fact that

* Read before The Johns Hopkins Hospital Medical Society, May 7, 1917.

they may give rise to serious and even fatal hemorrhage into the pelvic and abdominal cavities, as I have shown in a recent paper.[1] In this I collected 39 previous cases of grave abdominal hemorrhage of ovarian origin, and reported a fortieth in which the hemorrhage was due to the rupture of a small follicular cyst of the ovary.

Aside from such extreme instances of what may be called perforative ovarian hemorrhage, great interest attaches to the study of hemorrhages which are confined within the ovary. Considering the great frequency of ovarian hemorrhages, it seems difficult to assume that their occurrence can be looked upon as being invariably pathological. In view of the physiological nature of the hemorrhage which occurs periodically from the uterus, *i. e.*, the menstrual flow, it does not seem impossible that the study of ovarian hemorrhage may perhaps throw some light on the still mysterious mechanism of menstruation and ovulation. A number of studies have been made of the subject of ovarian hematomata, but there has been no effort, so far as I have been able to learn, to study them from the viewpoint of the physiological functions of the ovaries.

The material upon which this study is based was derived from 85 cases in which one or both ovaries had been removed at operation. Some of these ovaries contained only one hematoma, some a great many. The selection of this material was made relatively simple by the obviousness of hematomata on naked eye examination. I need not say that in all cases the ovaries were cut into at various planes, for the surface appearance of an ovary is of little importance as an index of its internal structure. The study has aimed to include all hemorrhagic lesions encountered, so that the series includes small follicular hemorrhages as well as the larger hematomata of pseudoneoplastic type. In other words, it was not limited to the comparatively small group in which the blood tumor was so large as to give rise to the symptoms which indicated operation. By far the largest proportion of hematomata studied, as a matter of fact, were quite small, not exceeding 2 cm. in diameter. These smaller lesions afford a much better opportunity than the more extensive ones of solving the important question of pathogenesis. The largest hematoma in this series measured 6 cm. in its longest diameter. Larger ones than this are relatively rare.

Hematomata of the ovary have been variously classified. We are not here concerned with those rare forms of ovarian hemorrhage that are produced by such conditions as a ruptured ovarian pregnancy, rupture of ovarian varices, bleeding from malignant ovarian tumors, etc. Nor are we concerned with the incidental hemorrhages which often occur into large ovarian cysts. The more intrinsic forms of ovarian hemorrhage, with which this paper deals, are classified by Von Beust[2] into those occurring in the stroma of the ovary, those in the follicles and those in the corpora lutea. Wolf's[3] division, which seems less logical, is into the interstitial, follicular and intra-follicular varieties. This classification is practically the same as that of Pfannenstiel.[4] Klob[5] recognizes only follicular and parenchymatous forms of hemorrhage, speaking of the latter as "ovarian apoplexy." Rollin's[6] classification, so often quoted, would seem to be the most complex and least satisfactory of all. He subdivides ovarian hemorrhages into (1) multiple vesicular, in which a number of follicles are filled with blood; (2) extravesicular, in which the hemorrhage has broken into the abdominal cavity; (3) intravesicular, in which the follicle wall resists the pressure of the blood, so that a large hematoma is formed; (4) hemorrhage into a hydropic follicle, the contents being a sanguinolent fluid instead of pure blood; (5) hemorrhage into a corpus luteum. The classifications suggested by other authors (Oehman,[7] Savage[8] and others) differ in no important respect from those already quoted.

In investigating the material on which this paper is based, I was impressed by the fact that, in the overwhelming proportion of cases, hematomata of the ovary are the result of hemorrhage into the follicular structures, including under this head the corpus luteum, which is a derivative of the Graafian follicle.

For a proper understanding of the pathogenesis of ovarian hematomata, the first essential is a knowledge of the blood supply of the Graafian follicle and of the corpus luteum. The vascular supply of the maturing follicle is found in its theca interna, the vessels of which form a veritable wreath around the follicle. From this, tiny vessels make their way concentrically inward toward the granulosa, in which, however, no distinct vascular channels can ordinarily be made out. It has now been fairly well established that the discharge of the ovum occurs without any appreciable bleeding either into the abdominal cavity or into the follicle lumen. Following the rupture of the follicle, *i. e.*, in the earliest stages of the corpus luteum, there becomes evident a much richer development of the blood supply, so that this early stage in the life history of the corpus luteum is often spoken of as the stage of hyperemia. Not only do the vessels in the theca become larger and more numerous, but within this, at the base of the granulosa, which it thus marks off from the theca, there appears a delicate festoon of small vessels which completely surrounds the corpus, forming a rather striking line of demarcation between granulosa and theca. This subgranulosal vascular wreath is of great importance, because from it spring the capillary channels which later irrigate the granulosa cells, coincidentally with the lutein transformation of the latter. Once the lutein layer is well established the subgranulosal vascular wreath becomes less conspicuous. The thecal stratum of blood vessels, however, appears to be quite distinct throughout the active life of the corpus luteum, and even well into the period of retrogression.

Furthermore, it is usually quite definite in those follicles whose development becomes arrested at various stages, through the process known as atresia folliculi—a term which seems to have become generally accepted in spite of the fact that it is far from satisfactory. As is now well known, only one follicle each month undergoes full maturation, followed by rupture and the development of a corpus luteum. Many more, however, develop up to a certain point, at which their further

growth is inhibited by some influence, as yet unknown, but which probably emanates from the "presiding ovum" of the month. The arrest of follicular development is characterized by the death and disappearance of the ovum in the atretic follicle, together with a gradual disintegration of the membrana granulosa. It is thus easy to explain the various types of follicular cyst which are so commonly encountered clinically. For example, the small microscopic cyst with perhaps a single layer of low cuboidal epithelium represents a follicle blighted in its very early stages. The larger cyst cavities, with several layers of lining epithelium, correspond to follicles whose development has been inhibited after they have progressed well on toward complete maturity. Again, the cavities in which the surrounding epithelium has long since disappeared, and which are undergoing a genuine atresia by the formation of a cicatrix-like inner layer of fibrous tissue, represent very late stages, illustrative of the ultimate fate of the atretic follicles. The terminal product is the so-called corpus fibrosum, which it would seem well to distinguish from the corpus albicans, the end result of the corpus luteum.

The more important elements of the ovary are therefore all of follicular origin, namely, the Graafian follicle itself, the atretic follicle and the corpus luteum. The last-named is so specialized in function that it deserves separate consideration. Hemorrhage may occur in any one of the structures already enumerated, and also occasionally in the stroma of the ovary itself. The various forms of ovarian hematoma may thus be classified as follows:

Follicular { **Graafian follicle.** / **Atretic follicle.**

Corpus luteum.

Stromal.

Hemorrhage into the Graafian Follicle.—Although practically all writers speak of the possibility of hematoma arising from hemorrhage into the Graafian follicle, it is my impression that this form of follicular hemorrhage is not by any means so common as has been believed. Practically every ovary during reproductive life contains many follicles which show degrees of development varying from the primordial follicle up to the fully mature structure. All of these advancing follicles, however, are characterized by relatively thick walls and by a moderate degree of thecal vascularity. The only exception to this is found in the case of the one follicle which is, as it were, chosen for full fruition and rupture each month. This follicle is larger and possesses a much richer blood supply than those which it has outstripped in development, although its walls are certainly much less vascular than those of the early corpus luteum. For the above reasons it is difficult to imagine that hemorrhage into a virile Graafian follicle would be common, except perhaps in the mature or almost mature forms. Even if such hemorrhage does occur, it is not easy to distinguish it histologically from the more usual type of hemorrhage into atretic follicles. In the former the hemorrhage brings about the death of the ovum, whereas in the latter the ovum has disappeared before the hemorrhage has occurred. It would not be possible to distinguish these two histologically except in the few instances in which sections are obtained showing hemorrhage into follicles still containing the ovum and discus proligerus, *i. e.*, before the ovum has been destroyed.

Hemorrhage into Atretic Follicles.—This is the most frequent form of follicular hemorrhage. The condition of the ovary commonly spoken of as cystic degeneration is caused by a marked stimulation of the ripening process in many follicles, resulting in the formation of a large number of atretic follicles, clinically termed follicular cysts. It is extremely common to find that a greater or less number of these cystic follicles are the seat of hemorrhage, giving rise to the most frequent form of follicular hematoma. It is of interest to study the pathogenesis of this form of hematoma. The atretic follicle is usually lined with only one layer of epithelium; and in the later stages this also disappears. In the cystic stage, therefore, before the process of atretic obliteration has begun, it is usually a thin-walled structure containing fluid under a considerable degree of tension, as may be judged by the smooth outline of its wall. Surrounding the follicle is the theca with a vascular wreath. The point to be emphasized is the richness of this blood supply, in view of the fact that the atretic follicle is looked upon as a retrogressive structure. The veins especially are large and distended. That this is not a mere stasis or pressure hyperemia would seem to be indicated by the fact that only certain types of atretic follicle are thus characterized, and that, as I shall show later, it is only at certain stages of the menstrual cycle that this change is noted.

It can be easily understood that this perifollicular wreath of thin-walled veins is an important predisposing factor to hemorrhage. Primarily this hemorrhage is practically always perifollicular. Extensive extravasations of blood are frequently observed surrounding large segments of the follicle, often dissecting away the epithelium and causing great bulging into the lumen. Fig. 1 shows such a perifollicular hemorrhage with impending rupture into the cavity. Fig. 2 illustrates the next stage, in which the epithelium has just been broken through, the blood now filling the cavity. In the case of the large follicular cysts into which free hemorrhage takes place, it is evident that large ovarian hematomata may be formed. More commonly, of course, the atretic follicle is small and the hemorrhage not great, so that the resulting hematoma is of small size. The bleeding from the wall is often so slight that the cavity is only partially filled (Fig. 2). Not infrequently the bleeding seems to have recurred, perhaps a number of times, the extravasated blood in the lumen being given a ripple-like appearance. Sometimes rather large hematomata may be caused by the confluence of two or more adjacent ones.

These observations would seem to refute the views of Savage and others that hemorrhage into the stroma is secondary to hemorrhage within the follicle, the blood escaping from the latter when the tension ruptures the wall. The present study would indicate that the real process is just the reverse, that is, the primary hemorrhage occurs in the perifollicular stroma and later breaks through into the follicle.

It is not always easy to distinguish this form of follicular hematoma from genuine stromal hemorrhage, on the one hand, and hemorrhage into corpora lutea, on the other, even with the aid of the microscope. A non-follicular stromal hemorrhage may be surrounded by a condensed layer of fibrous tissue quite similar to the wall of an atretic follicle from which the epithelium has perhaps long since disappeared. Equally perplexing may be the differentiation between simple follicular hematoma and that which arises in a corpus luteum. As is now well known, the theca cells of the atretic follicle often undergo a definite lutein-like transformation, and hemorrhage into a follicle surrounded by a zone of these theca-lutein cells is not always easy to distinguish from an old corpus luteum hematoma in which the lutein cells have undergone marked retrogression.

Corpus Luteum Hematoma.—For a proper understanding of the histology of hematomata of this type, a knowledge of the life history of the corpus luteum is essential. This I have described elsewhere,[8] and I shall not review it here. Contrary to what has been the common belief, it is not characteristic to find the cavity of the follicle filled with blood immediately after its rupture. The walls of the corpus luteum in these very early stages, however, are very vascular, the subgranulosal vascular ring being especially marked. There is no dividing line between this stage and that of vascularization. As a matter of fact, it is common for the early corpus luteum to exhibit the hyperemic stage in some parts of its wall, while others have passed on into the stage of vascularization. In the latter the lutein layer becomes thickly irrigated with capillaries springing from the subgranulosal zone. It is in this time period of the corpus luteum that a moderate amount of hemorrhage normally takes place into the lumen. It is found in all the corpora lutea of this stage that I have examined. The hemorrhage is moderate in amount and usually uniform in distribution, the escaped blood forming a narrow zone adhering to the inner layer of the lutein zone.

It is not surprising, however, that in certain instances this hemorrhage overshoots the mark, as it were, the cavity of the corpus being inundated. Thus is produced one very common form of what is clinically called a corpus luteum cyst (Fig. 3). The statement has generally been made that corpus luteum cysts invariably contain blood. With certain qualifications which will be discussed later, this statement is correct.

Many of the structures which the gynecologist speaks of as corpus luteum cysts are merely corpora lutea in which an unusual amount of bleeding has occurred. It is probable that in many of these the lutein cells remain virile and functionate normally, and that the abnormal amount of hemorrhage has no important effect on the subsequent history of the corpus luteum. In other cases it is conceivable that the hemorrhage may be so great that the further development of the functioning cells is arrested and that a genuinely pathological hematoma results. There is no sharp dividing line between the physiological and the pathological in this respect, any more than there is between the uterine bleeding of normal menstruation and that which constitutes menorrhagia.

Hemorrhage from the wall of a corpus luteum in the stage of maturity is probably rare. The walls of such a corpus are usually very thick, the blood vessels are thick-walled and lie more deeply, and there is a more or less well-defined layer of fibrous tissue along the inner edge of the lutein zone. Even if excessive hemorrhage occurred in this stage it would seem impossible to distinguish the resulting hematoma from the usual type already described, in which the hemorrhage arises during the stage of vascularization, and in which the wall later undergoes the same maturation observed in the normal corpus (Fig. 4). In a certain number of hematomata, which because of their yellow lining are clinically called corpus luteum cysts, the walls are found to be those of retrogressive corpora lutea. In these cases, for reasons similar to those above mentioned, it is almost certain that the initial bleeding occurred in the stage of vascularization, and that the blood has persisted to the period of retrogression of the follicle. This is not surprising when one considers that the entire time elapsing between the periods of late vascularization and early retrogression of the corpus luteum may be little more than a week.

The especial characteristic of old corpus luteum cysts is the fact that the lutein layer is atrophic and degenerated, and that it is separated from the lumen by a distinct and often wide zone of connective tissue (Fig. 5). The contents are usually old blood. Instead of filling the cavity completely, the hemorrhagic elements often form only a narrow layer adhering to the wall of the cyst, the remainder being a clear serous fluid. This type of cyst is very common. It is certainly a pathological structure, although its clinical significance is often negligible.

The multiple lutein cysts which are at times found in the ovaries in association with either hydatidiform mole or chorio-epithelioma, and which contain no blood, need not be considered at length here, inasmuch as they are not corpus luteum cysts in the proper sense. The lutein cells which are found in the walls of these cysts are theca lutein cells and not granulosa lutein cells. Even in the course of normal pregnancy there is a great overproduction of atretic follicles, with a lutein-like transformation of the theca interna cells, giving rise to the so-called interstitial glands. It seems impossible to explain this in any other way than as due to a hormone emanating from the embryo. When the latter is pathological, as in hydatidiform mole or chorio-epithelioma, it is not surprising that there should also be a pathological condition in the ovary. Since in both these conditions, there is an overproduction of trophoblastic tissue, the thought suggests itself that the hormone which is linked up with ovarian activity is produced by the trophoblast, and that the excess of the latter in these two diseases is responsible for the remarkable polycystic lesions which may occur in the ovary. In the two specimens of this condition which I have had an opportunity of studying, the lutein cysts presented a picture quite different from the ordinary corpus luteum cyst. The lutein cells rarely form a complete or uniform layer. They are usually large, more or less polyhedral, taking a rather purplish hematoxylin stain. The lutein zone is often buried beneath a deep stratum of

fibrous tissue, indicating that the atretic follicle in which this lutein transformation of the theca had occurred had been well advanced in the atretic process. The whole picture suggests that wherever the thecal cell persists, it possesses a peculiar sensitiveness to the trophoblastic hormone, which seems to be responsible for the lutein transformation in the theca cells.

Stromal Hemorrhage.—Certainly there would seem to be little doubt that of the three principal types of ovarian hemorrhage, the least common by far is that which occurs in the stroma directly, *i. e.*, without any relation to follicular elements or derivatives. As I have already emphasized, practically all forms of ovarian hemorrhage take their origin from the perifollicular vessels and hence are initially stromal in this narrow sense. Far less frequently ovarian hematomata are the result of the rupture of ovarian vessels into the stroma, without relation to follicular structures. Hemorrhages of this type are, perhaps, better entitled to the designation "apoplexia ovarii" than those already described. The resulting hematoma is not always easy to distinguish from the form caused by hemorrhage into an atretic follicle, as has been explained in connection with the description of the latter. In some cases, however, the distinction can be made from the irregular outlines of the stromal hemorrhage, the blood apparently forcing itself under tension along the tissue interstices (Fig. 6). That such forms of hemorrhage may occur in very young children or even in the fœtus is shown in the cases reported by Riedel [10] and Schultze.[11] In Schultze's case, a hematoma of the right ovary measuring 1¾ inches in diameter was found in a child which was born dead. The thickened albuginea and the vascularity of the peritoneum demonstrated, in Schultze's opinion, that the hemorrhage was of gradual development, continuing over a period of several weeks before the death of the fœtus. Riedel's case was very similar to that of Schultze.

Causes of Ovarian Hemorrhage.—No definite statement can be made as to the exciting cause of the hemorrhages which result in the formation of ovarian hematomata. It is true that many explanations have been offered for their occurrence, but in practically all cases the factors held responsible are to be looked upon as predisposing rather than exciting. These causes are, perhaps, best summarized in the following tabulation given by Stein:[12]

Local
1. Menstrual (excessive menstrual hyperemia).
2. Non-menstrual.
   - (a) Active hyperemia, as acute or chronic oöphoritis.
   - (b) Passive hyperemia, as thrombosis, torsion, varix.
   - (c) Primary and secondary neoplasms.

General
1. Diseases altering the composition of the blood.
   - (a) Infectious diseases, as typhoid, acute exanthemata, etc.
   - (b) General disorders of nutrition, as anemia, chlorosis, etc.
   - (c) Hemophilia.
2. Phosphorus poisoning.
3. Burns.
4. Venous congestion of abdominal viscera, as in heart or lung disease.

Cases illustrating the rôle of all these possible causes are to be found in the literature. I shall make no effort to review them here.

Etiological Rôle of Menstruation.—The principal point in the consideration of the etiology of these hemorrhages is the rôle played by the hyperemia of menstruation. The statement is passed on from author to author that ovarian hemorrhages are commonly due to the ovarian congestion which is said to be a part of the menstrual phenomenon. Cases have even been reported by Garrigues,[13] Gottschalk [14] and others in which large ovarian hematomata were explained as due to a species of vicarious menstruation into the ovary. This is said to occur when there is an obstacle to the exit of the menstrual blood *per vias naturales,* as after destruction of the endometrium by excessive curetting, etc. So far as I know, no proof has ever been brought forward for the correction of such views, and, indeed, no one has ever studied the problem from the viewpoint of the menstrual histories of the patients. I have, therefore, laid especial stress upon this point in the study of my own cases.

An analysis of my results yields several facts of great interest. In the first place it was noted that hematomata were most commonly found in ovaries removed at a period corresponding to the probable occurrence of ovulation, *i. e.*, from about the seventh to the sixteenth day. In practically all these cases the hemorrhage is obviously recent, or, in a few cases, it has not yet occurred but is impending. In the few cases in which hematomata are encountered in ovaries removed late in the menstrual cycle, histological examination shows that the extravasated blood is old and more or less disorganized, thus indicating again that the hemorrhage had occurred some time previously. The evidence from this group of cases, therefore, would indicate that follicular hemorrhages of the ovary, and the perifollicular congestion which precedes them, occur by predilection at or near the time of ovulation. As to the significance of these perifollicular vascular changes, I do not venture to express an opinion. That they are purely physiological, and that they are in some way called forth by the influence emanating from the "presiding ovum" of the month, would seem a natural assumption.

When we turn our attention to the time study of corpus luteum hematomata, the findings are somewhat different. The corpus luteum hemorrhages occur rather later, from about the sixteenth to the twenty-fifth day. This is exactly what we would expect if we bear in mind that most of these hematomata have their inception in the period of vascularization of the corpus luteum. As in the case of follicular hemorrhages, a careful study of the individual cases will usually serve to explain the apparent exceptions to the general rule. For example, a corpus luteum hematoma (Gyn. No. 20404) removed on the fifth day of the cycle contained old blood, and was surrounded by a broad fibrous layer within the retrogressive lutein layer. This was clearly a structure which had persisted from the preceding month and perhaps even longer. In this way, and only in this way, by careful clinical and histological correlation and by using the normal life history

as a criterion, can one interpret the various forms of ovarian hematomata which are encountered.

Effect of Hematomata upon Menstruation.—A careful analysis of the menstrual histories in the cases of this series shows that small hematomata, of whatever variety, have apparently no effect on the character of menstruation. Indeed, the only significant effect observed was in the case of the largest hematoma in the series, measuring 6 cm. in diameter. The ovary was little more than a shell, the ovarian tissue which remained at one pole showing no corpora lutea, either recent or old. The other ovary had been removed three years previously. It is, perhaps, not surprising to know that this patient had not menstruated for many months. In those cases of this series in which menstrual disorders were noted, they were practically always attributable to the coexistent pelvic disease. Certainly there is no ground for the belief held by many that the characteristic symptom of ovarian hematoma, whether of the follicular or corpus luteum type, is excessive menstruation.

Associated Pelvic Lesions.—Some of the ovaries in this group of cases would in themselves be considered relatively normal; others show extensive pathological change, such as cystic degeneration or abscess formation. In every case there was, of course, a greater or less degree of pelvic disease coexistent. By far the largest number of patients suffered with pelvic inflammatory disease. Next most frequent were the myomata; then the carcinomata, ovarian cysts and other common pelvic diseases. In other words, hematomata were, in this series of cases, found in association with practically all the usual forms of disease. Even when the removed ovaries were to all intents and purposes normal, as in some of the cases of early carcinoma of the cervix, hemorrhagic lesions of the ovary were often encountered. There can be no doubt, however, that hematomata are far more common in pathological than in normal ovaries. Martin [15] found in 134 cases of ovarian hematoma that the ovaries were diseased in 88.8 per cent and normal in 11.2 per cent. Especially important as a predisposing factor would seem to be the condition commonly spoken of as cystic degeneration of the ovary, which is due to a stimulation of follicular growth and the production of an excessive number of atretic follicles.

Summary.—The present investigation was based on the study of material from 85 cases in which one or both ovaries, containing hematomata, had been removed at operation. In the overwhelming majority of cases hematomata occur in connection with the follicular structures of the ovary, although occasionally they may be the result of hemorrhage directly into the ovarian stroma. They are best classified as of the follicular, corpus luteum or stromal type.

The first-named group, *i. e.*, the follicular, comprises those due to hemorrhage into the maturing Graafian follicle and those due to bleeding into the atretic follicle. The latter form is the most frequent of all, representing the common clinical type of follicular hematoma. In the follicular type, the source of the hemorrhage is definitely traceable to the vascular ring surrounding the follicle. Such hemorrhages are primarily perifollicular and therefore stromal, but when sufficiently great they break through into the cavity of the follicle, forming either large or small hematomata, as the case may be.

The corpus luteum hematoma is also very common, being distinguished by its yellowish wall of lutein tissue. The various clinical types of corpus luteum cysts are explainable by reference to the normal life history of the corpus luteum. The latter, like the growing Graafian follicle, may be arrested at almost any point by the occurrence of excessive bleeding into the cavity. This is especially common during the stage of vascularization, in which a moderate amount of bleeding into the corpus lumen takes place as a normal phenomenon.

Stromal hemorrhage, or "apoplexia ovarii," is not frequent, occurring most often in the course of infectious diseases, or with severe local inflammatory lesions. It has, however, been observed in the fœtus and in the very young child.

A careful study of the menstrual histories of the cases on which this paper is based shows that the hemorrhage which causes follicular hematomata occurs characteristically at or near the supposed time of ovulation, *i. e.*, between the seventh and sixteenth days of the menstrual cycles. The bleeding of corpus luteum origin, as might be expected, occurs later, being apparently only an exaggeration of that normally occurring in the stage of vascularization. There is no characteristic menstrual history associated with the presence of hematomata in the ovary.

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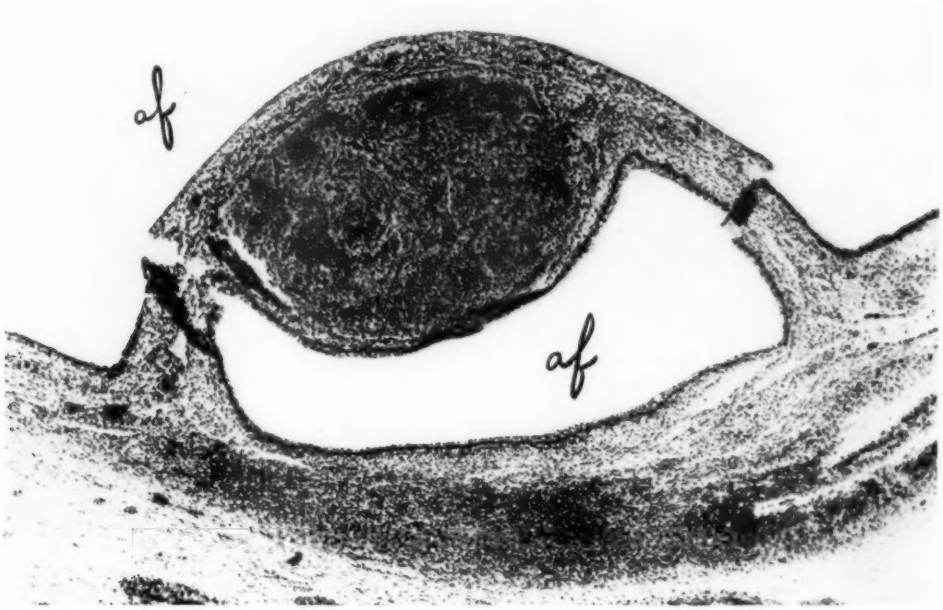

FIG. 1.—Perifollicular hemorrhage in septum between two adjoining atretic follicles (*af*). Rupture into the smaller follicle is obviously impending.

FIG. 2.—Perifollicular hemorrhage (*p*) which has just broken through epithelial lining (*ep*) of atretic follicle (*af*) into its lumen.

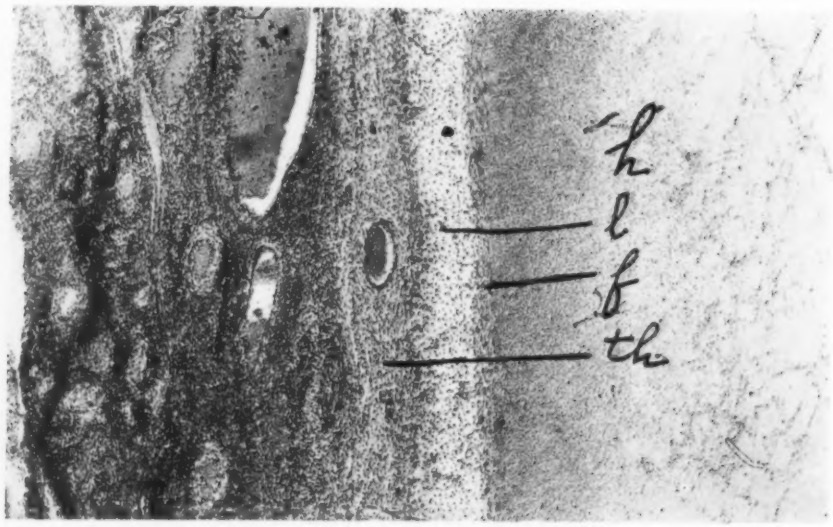

FIG. 3.—Wall of corpus luteum cyst, 5 cm. in diameter, which has apparently resulted from excessive hemorrhage during stage of vascularization. *h*—hemorrhagic contents; *f*—light layer of fibrous tissue which has developed inside the lutein layer (*l*); *th*—theca folliculi.

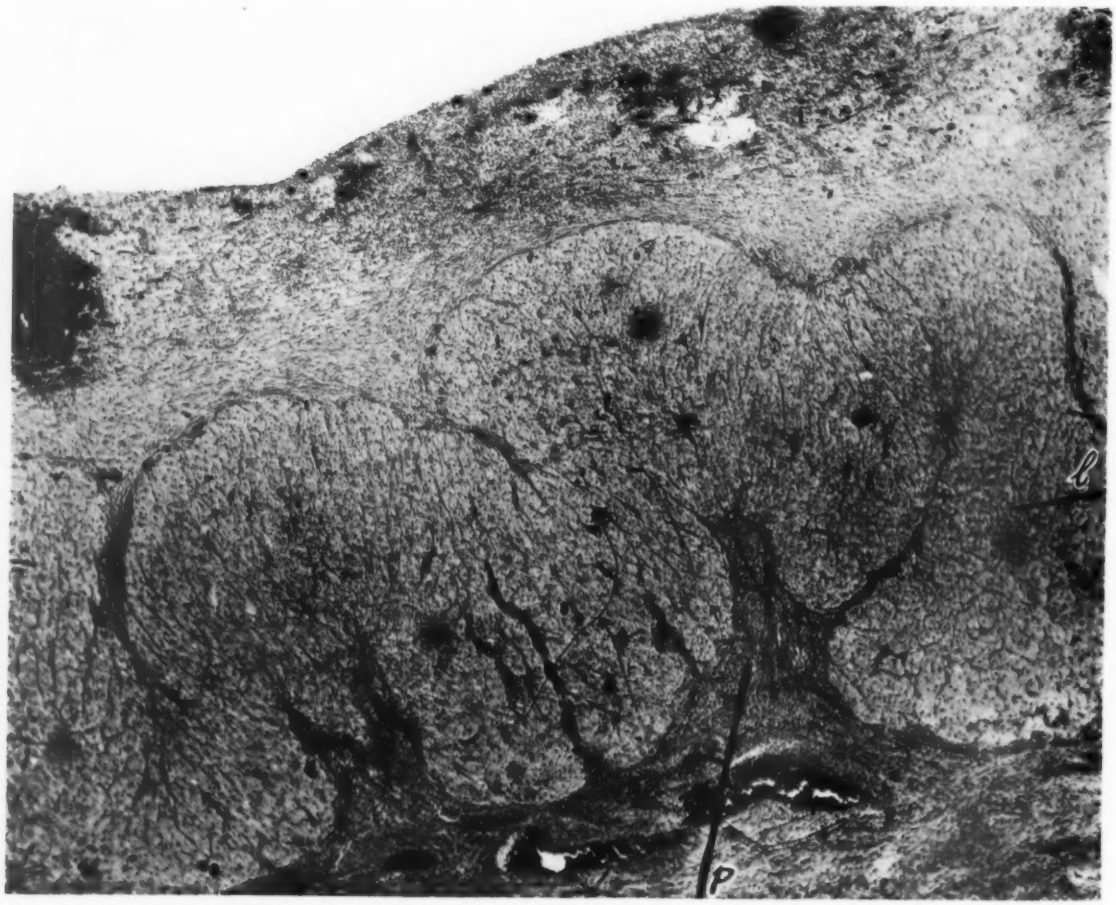

FIG. 4.—Wall of corpus luteum cyst, 4 cm. in diameter, in which the lutein layer has preserved its virility, and has advanced to full maturity. *l*—lutein layer; *p*—paralutein cells in theca.

FIG. 5.—Wall of old corpus luteum cyst. Note broad zone of dense fibrous tissue (*f*) within the retrogressive lutein layer (*l*).

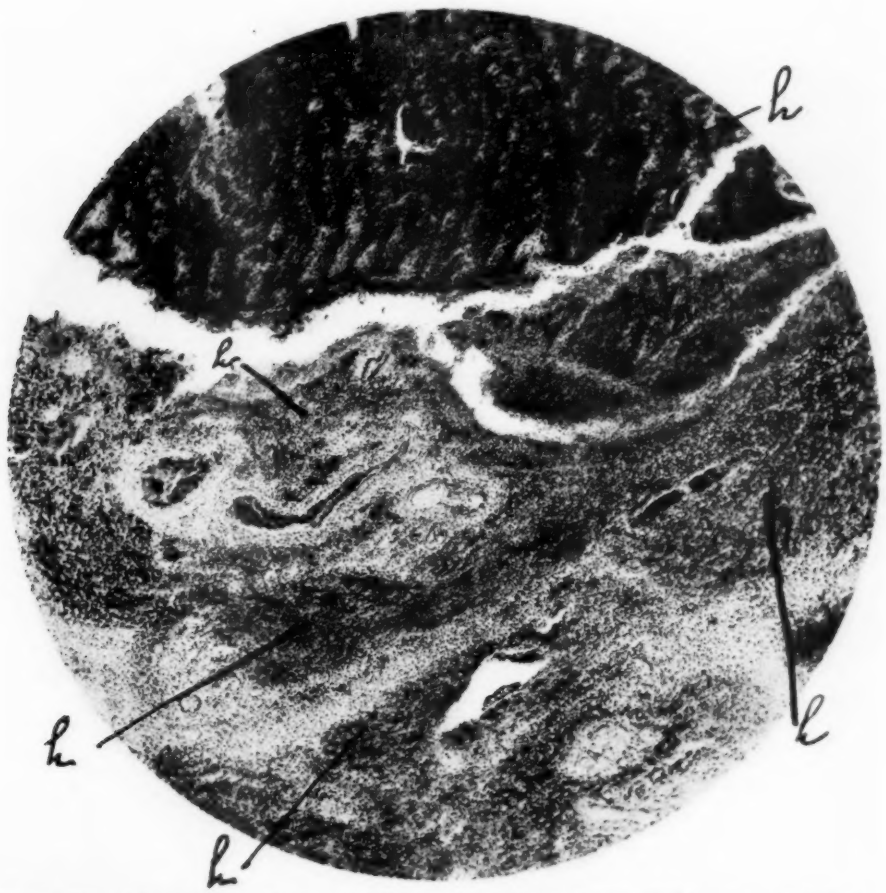

FIG. 6.—Stromal hemorrhage, with characteristic irregular outlines. Note arms of hemorrhage (*h*) projecting themselves into ovarian stroma, islands of which are left here and there.

ABSTRACTS OF PAPERS

Representing Work Done in The Johns Hopkins Hospital, but Published or to be Published Elsewhere than in the Bulletin. Prepared by the Authors.

ON THE EFFECTS OF INJECTION OF HYPOPHYSEAL EXTRACTS (POSTERIOR LOBE AND PARS INTERMEDIA) IN THE TREATMENT OF DIABETES INSIPIDUS.*

By LEWELLYS F. BARKER, M. D., and HERMAN O. MOSENTHAL, M. D.
(From the Department of Medicine, The Johns Hopkins Hospital.)

The effects of injection of the pars intermedia and of the posterior lobe of the hypophysis cerebri in controlling the symptoms in diabetes insipidus are well illustrated by the case reported in this paper. The patient, a woman of middle age, had suffered from excessive thirst and extreme polyuria for several months. The urinary output was, at times, as much as 11 liters in the 24 hours. Work and sleep were seriously interfered with and the patient had become very nervous. The urine was of very low specific gravity, and the kidneys, as in similar cases, seemed unable to secrete a concentrated urine.

On subcutaneous administration of hypophyseal extracts (posterior lobe and pars intermedia) it was found possible completely to control both the polyuria and the polydipsia, and to raise the concentration of the urine to a normal level. Two doses of 1 c.c. each in the 24 hours were sufficient. The patient's nervousness was greatly mitigated and sleep returned. The only other effect noticeable was a movement of the bowels after each injection.

Many other forms of treatment were tried in this case but without benefit. Tethelin and adrenalin had no appreciable effect upon the polyuria.

The writers feel that their experience in this case is confirmatory of the reports of others who assert:

1. That diabetes insipidus is to be looked upon as an endocrinopathy, being due to an insufficiency of the pars intermedia of the hypophysis cerebri.

2. That the symptoms of diabetes insipidus can be controlled by a substitution therapy; namely, by the subcutaneous injection of extracts of the posterior lobe and pars intermedia of the hypophysis cerebri.

ON THE CONTROL OF DIABETES INSIPIDUS BY MEANS OF HYPOPHYSEAL EXTRACT IN A MULTIGLANDULAR ENDOCRINOPATHY (THYREO-HYPOPHYSEO-GENITAL SYNDROME).†

By LEWELLYS F. BARKER, M. D., and MARY HODGE, M. D.
Baltimore, Md.
(From the Department of Medicine, The Johns Hopkins Hospital.)

The paper includes the report of a case of multiglandular endocrinopathy with symptoms referable to the thyroid gland, the hypophysis cerebri, the inter-renal system, and the gonads. Diabetes insipidus, manifested by the patient, is regarded by the writers as a hypophyseal symptom insufficiency of the pars intermedia). The polyuria and the polydipsia were controllable in this patient by subcutaneous injections of extracts of the posterior lobe (and pars intermedia). With the injections, the kidneys became able to secrete a concentrated urine. The simultaneous existence of symptoms referable to disturbances of endocrine glands other than the hypophysis did not seem to diminish the efficiency of the hypophyseal-hormone therapy.

ON A REGIMEN THAT HAS BEEN FOUND HELPFUL IN THE TREATMENT OF SOME CASES OF SO-CALLED PERNICIOUS ANÆMIA.*

By LEWELLYS F. BARKER, M. D., and THOMAS P. SPRUNT, M. D.
(From the Department of Medicine, The Johns Hopkins Hospital.)

The paper, after discussing briefly the classification of the severe anæmias, their etiology and pathogenesis, describes a regimen used by the writers in the Addison-Biermer type of pernicious anæmia which they define as a hæmolytic anæmia of as yet unknown etiology. They report that in one group of cases they have had a favorable response on applying the regimen they describe, whereas in another group of cases, indistinguishable before applying the regimen, a favorable response was not met with.

The regimen used by the writers, summarized, includes:

1. Treatment in a private room in a hospital or nursing-home.

2. Isolation and complete rest in bed under the care of a special nurse and the physicians.

3. Careful search for focal infections, and radical surgical removal of any such infections found (especially of infections of the teeth and gums).

4. Milk diet at first, followed by mixed diet rich in protein, the patient being encouraged to eat despite lack of appetite, and disregarding any consequences that may follow the ingestion of the food.

5. An abundance of fresh air, the bedroom windows being kept constantly open when the patient is inside, and the bed being run out upon an open porch in all suitable weather.

6. Dilute hydrochloric acid with and after meals on account of the gastric anacidity, followed three hours after each meal by 45 grains of pancreatin and 45 grains of calcium carbonate. If the pancreatin is not easily taken by the patient, it is omitted as one of the less important features of the treatment.

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* Paper read before the Association of American Physicians, Atlantic City, 1917. To be published in the Transactions of the Association and in the Journal of Urology.

† The full report will be published in *Endocrinology*.

* Paper read at the American Medical Association, New York, June, 1917. To be published in the Journal of the American Medical Association, or in the Reports of the Medical Section of the Association, 1917.

7. Arsenic, usually in the form of cacodylate of soda or small doses of salvarsan, is administered as a routine. When cacodylate is given, 50 milligrams are injected intramuscularly once a day for eight days, and after an interval of two weeks a second course of eight injections is given.

8. Massage thrice weekly is given while the patient is in bed. When the hæmoglobin reaches 60 per cent, gentle exercises are begun in bed; when it reaches 80 per cent, the patient is allowed gradually to sit up and to take gentle exercise in the open air.

9. Blood transfusions are employed only in patients who on admission have a blood count below 1,000,000, or who after a trial of several weeks of the above regimen have not shown distinct improvement.

Splenectomy has not been used in the series of cases mentioned.

To the paper are appended the case summaries and blood charts of seven illustrative cases.

SOME OF THE PROBLEMS OF PLASTIC SURGERY.*

By John Staige Davis, M. D., F. A. C. S.

(*From the Department of Surgery, The Johns Hopkins Hospital.*)

By plastic and reconstructive surgery I mean that branch of surgery which deals with the repair of defects and malformations, either congenital or acquired, and with the restoration of function and improvement of appearance.

The deformities dealt with in plastic surgery for the most part involve the skin or adjacent soft parts, rather than the bones and joints, the ligaments or tendons. The treatment of large denuded surfaces, requiring skin grafting, and of intractable wounds, should also come under the care of the plastic surgeon.

My experience has been that we seldom, if ever, find two plastic cases exactly alike, and thus no "cut and dried" methods can be employed.

The results in certain groups of cases are very slow, and in these the process is one of gradual building up. In such cases the entire series of operations should be planned with regard to the ultimate result, and not to the immediate relief of the condition.

The postoperative treatment and dressings should be done by the surgeon himself, or directly under his eye.

The simpler the operation the more likely it is to succeed, and this is especially exemplified in the operations for the relief of hare-lip.

It is wise to make haste slowly in plastic surgery, and to underdo, rather than overdo.

Thorough familiarity with the free transplantation of skin, fat, fascia, bone and cartilage is essential, as all of these tissues are constantly utilized in reconstructive work. The principles of tissue shifting, and of the use of pedunculated flaps, must be understood.

Transplantation of Skin.—The use of skin grafts is absolutely essential in plastic surgery. Skin grafts may be divided in general into *thin grafts,* where only the superficial layers are utilized and *thick grafts,* where the whole thickness or nearly the whole thickness of the skin is used. This latter division includes *small deep grafts.*

Grafts may be further classified into *auto-grafts,* where the graft is obtained from the same individual; *iso-grafts,* where the graft is obtained from another individual of the same species, and *zoö-grafts,* where the graft is obtained from a lower species.

I will not go into the technic of obtaining these grafts, but will only say that both thin and thick grafts may be successfully transplanted on healthy granulating surfaces, as well as on fresh wounds.

Iso-grafts.—I feel convinced that, when it is not possible to utilize *auto-grafts, iso-grafts* are well worth trying, and very good lasting results may be secured if the grafts are obtained and transplanted with the proper technic.

Zoö-grafts.—My own experience is that these grafts take readily and receive their blood supply as promptly as ordinary grafts. However, after doing well, and often when the wound is entirely healed, they will suddenly from no apparent cause begin to melt away, and will soon disappear.

Transplantation of Fat.—Free-fat-grafts are used principally for filling in depressions. They can be successfully transplanted and enough of the tissue will survive to accomplish the desired purpose. This tissue must be most carefully handled to prevent bruising. The defect into which it is placed must be perfectly dry and asepsis must be maintained.

Transplantation of Fascia.—Fascia is used in plastic surgery for a number of purposes. It is valuable for reinforcing weakened or defective tissues. New tendons may be constructed of it. It may be used alone or with fat in joints.

Transplantation of Bone and Cartilage.—Bone and cartilage are normally the supporting framework for the soft parts, and both are used for this purpose in reconstructive surgery. It must be borne in mind that free grafts of bone, either with or without periosteum, when transplanted into soft parts, will eventually be absorbed. Cartilage will live and not shrink when transplanted free, both with or without its perichondrium, into soft parts, or when in contact with bone at one or both ends.

Mucous-membrane transplantation.—Free grafts of mucous membrane are of little value when transplanted to the eyelids or into the mouth.

Subcutaneous Hydrocarbon Prosthesis.—The injection of paraffin is principally used for correcting certain deformities about the face. However, paraffin often shifts its position gradually and trickles down the tissue planes; or perhaps infiltrated tissues may thicken and cause deformities which are much worse than the original defect.

* Read before the Philadelphia Academy of Surgery, March 5, 1917.

By a *flap* we mean a mass of tissue attached at some portion of its circumference by a pedicle, which can be shifted at once or later as far as the pedicle will allow.

By a *graft* we mean a mass of tissue which is cut free to be transplanted wherever necessary.

A surface may be closed in one of four ways: First, by skin grafting; second, by sliding the edges together and suturing; third, by pedunculated flaps from tissue in the immediate neighborhood; fourth, by pedunculated flaps from distant parts. This may be done by either a single or double transfer.

In all plastic operations it is advantageous that the patient should be in the best possible physical condition, and no plastic operation should be undertaken on those with active local disease still present.

The area into which the flap or graft is to be transferred should be perfectly dry, and all hemorrhage checked.

An accurate estimate of immediate and subsequent tissue shrinkage must be planned for.

One of the most important points in plastic surgery, when tissue of any kind is transferred, is that there be no tension either on flaps or on free grafts.

The shape of the flap must correspond fairly accurately to the defect which it is to cover.

The skin of pedunculated flaps, as well as of whole thickness grafts, must be chosen with some regard to the area into which it is to be placed. The flap must be cut at least one-third larger than the area it is to fill.

The pedicle should be as broad as possible. Always aim to have the pedicle very close to the loss of substance.

As a general rule the flap should not be longer than two and a half or three times the width of the pedicle. The pedicle should not be twisted enough to interfere with the circulation of the flap.

A flap may be cut much thinner if its pedicle contains a main artery.

Twisting or too much tension on a pedicle may cause the shutting off of circulation and subsequent death of the flap.

As a rule it is best to wait for from 10 days to two weeks before amputating the pedicle of a flap.

The area from which the pedunculated flap is taken may be closed with sutures if the skin is lax, or after undercutting and sliding.

Immobilization of the part with plaster, crinolin, or splint is essential, and the dressings next to the transplanted tissue should be soft and very carefully applied.

A graft of whole thickness skin may also be placed successfully in the midst of movable scar tissue, and accomplish its purpose.

It is rare in plastic surgery that we encounter a deformity which cannot be helped by logical surgical methods.

At best we can only accomplish a certain amount, trusting in nature to complete our work.

A CASE OF PNEUMONIA OF UNUSUALLY SHORT DURATION.*

By HENRY B. CONRAD, M. D.,

Assistant Resident Pediatrician, The Johns Hopkins Hospital.

That type of pneumonia which runs its course in from one to four days is termed by Wunderlich abortive pneumonia. The comparatively recent reports of Bechtold, Krafft and Kerr have made the condition more or less familiar. Except in duration the clinical picture does not differ materially from that of pneumonia running the usual course. The majority of cases reported have shown the physical signs of pulmonary consolidation. In one of the cases reported by Krafft the pneumococcus was found in the blood, and in two it was in the sputum.

As to the pathology there are no available data since there is no mortality. The opinion is generally held that the process does not pass beyond the stage of congestion. The Rœntgen-ray affords some help in solving the problem, but in using this the ignorance of what casts the shadow in pulmonary consolidation must be acknowledged.

In Case 1, D. B., the rœntgenogram failed to show a shadow until the ninth day, although the symptoms of pneumonia were typical and signs of consolidation were present from the start. The question is therefore raised whether intense congestion might not give the signs of consolidation and yet cast no shadow in the rœntgenogram.

The following case strongly suggests that in some cases of abortive pneumonia at least the process may go on to the stage of hepatization.

Case 2, C. D., age three years, showed the typical clinical picture of pneumonia. Defervescence was by crisis 18 hours after onset. The rœntgenogram showed a triangular area of consolidation peripherally located in the upper part of the left lung. The child made an uneventful recovery and the rœntgenogram four days after the crisis showed very slight remains of the consolidation.

ON THE GENESIS AND INHIBITION OF EXTENSOR RIGIDITY.†

By STANLEY COBB, ALBERT A. BAILEY and PAUL R. HOLTZ.

(From the Neurological Laboratory Henry Phipps Psychiatric Clinic, The Johns Hopkins Hospital.)

Decerebrate rigidity is a tonic contraction of those extensor muscles of the body which tend to hold the animal in a typical standing position; in Sherrington's words it is a "postural" reflex—a "Stell-reflex" according to Magnus.[4] This rigidity only takes place when the cerebrum and thalamus have been removed, so it is supposed that the inhibitory influences which normally check this tonic extension are exerted on some "tonus centers," in the mid-brain or hind-brain, by the cere-

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† Published in the American Journal of Physiology, September, 1917.

brum. These normally give rise to extensor tonus, but are controlled from above by inhibitory influences, so that the rigidity shows only when that control is removed.

In this investigation we wished to gather data bearing especially on this inhibitory mechanism. Accordingly, decerebrated cats were so suspended that levers, attached to their tonically contracting extensor muscles, would record on a drum the tone changes of these muscles. The cortex of the anterior lobe of the cerebellum was stimulated electrically, and inhibition of the rigidity was recorded, preponderantly in the ipsilateral muscles. This had been previously reported by other investigators. Next the cortex was removed and the electrode was placed deeply in the subcortical structures; on stimulation here more marked inhibition was obtained, and it was more strictly ipsilateral. Finally the anterior lobe of the cerebellum was removed, exposing the dentate-rubral tracts, which on stimulation gave still more marked and more purely ipsilateral inhibition.

The inhibitory pathway has been shown by Weed to lie in the "anterior mesial" part of the internal capsule and in the "mesial fraction" of the crus cerebri (perhaps the fronto-pontine bundle or the bundle of Arnold). He also found that stimulation of this area on the cut surface of the mid-brain caused ipsilateral inhibition of the existing rigidity, an observation which we repeated on two of our cats. Moreover, Weed traced the pathway into the contralateral middle cerebellar peduncle, showing that destruction of this pontile arm stopped the inhibitory action of stimuli applied to the above-mentioned point in the crus. Further than this, he found what he considered the possible cortical representation of this tract in the superior vermis. Stimulation of this cortex caused inhibition of the rigidity, and extirpation of it caused a marked increase in rigidity. Our experiments corroborate the inhibitory effect of the cerebellar cortex. The facts (a) that we have not always obtained an increase of rigidity ipsilaterally by extirpation of the anterior part of the lobus anterior, (b) that we have found subcortical stimulation more effective than cortical, and (c) that we have found direct stimulation of the underlying superior peduncle most effective of all and most definitely ipsilateral in effect, make us believe that the inhibitory path passes down the superior peduncle.

From these observations, it seems fair tentatively to propose a pathway for the inhibitory influences which control decerebrated rigidity. Weed has traced this through the internal capsule and crus (probably as fronto-pontine bundle) to the pons, thence up the opposite middle cerebellar peduncle, and possibly to the cortex of the lobus anterior. We present evidence which indicates that the pathway leaves the cerebellum in the superior cerebellar arm (brachium conjunctivum).

If we accept this as the inhibitory path, the theory that the genesis of the extensor tonus lies in the red nuclei becomes most plausible. Weed and Brown have shown that stimulation of the cut mid-brain in the region of these nuclei causes contralateral extension of the limbs. It is in the red nucleus that the inhibiting path seems to end. Therefore we may reason that normally the red nuclei give rise to tonic impulses causing an extensor posture, that these are controlled from above by inhibition along the pathway described, and that cutting this pathway allows over-activity of the nuclei and hence decerebrate rigidity.

In order exactly to determine the relation of the red nuclei to decerebrate rigidity, other experiments were carried out. Cats were prepared as above described, and their brain-stems were transected at levels both above and below and through the red nuclei. Notes on the duration and character of the resulting phenomena were made, and these were compared with the anatomical findings in serial sections of the brain-stem.

A comparison of the results of 18 preparations cut at various levels show a difference in character between the typical decerebrate rigidity of the mid-brain preparation, and the variable tonic extension of the hind-brain. When the red nuclei are present there is a steady rigidity. This rigidity can be inhibited by stimulating any point on the inhibitory pathway, and this path largely ends in the red nucleus. Therefore, it seems, a large part of the activity arises in the red nuclei; probably a reflex activity set up by the direct cerebellar tracts. When we cut further back so as to destroy this reflex arc, the tonic extension becomes less, but is still elicited by increasing the quantity of afferent stimuli. Even in cord lesions some types of rigid extension appear, and Magnus in a recent paper contrasts the postural reflexes of "pons animals" with those found in animals with the mid-brain intact. From the ontogenetic point of view Weed's paper on "The Reactions of Kittens after Decerebration" brings in more evidence to show that we are dealing with a complicated mechanism, the activities of which are graded according to the level of integration of the animal as well as the level transection of the neural axis. It is hoped that further investigation will throw some light on a subject the practical application of which is so great in relation to such problems as clonus, contracture, muscle tonus, and body posture.

Conclusions.

1. Stimulation of the superior cerebellar arm in decerebrate cats causes ipsilateral inhibition of their rigidity.

2. The inhibition of decerebrate rigidity by stimulation of the cortex of the anterior lobe of the cerebellum appears to depend on stimulation of the underlying superior cerebellar arm.

3. A kind of extensor rigidity (not the typical "decerebrate rigidity" of Sherrington) is found in preparations transected below the red nucleus. This extensor tonus is lost when the transection injures the vestibular nuclei.

4. Stimulation of the superior cerebellar arm elicits no inhibition of extensor tonus when the red nuclei are not left in the preparation, or when the dentate-rubral path is cut.

SOME EXPERIENCES IN THE GERMAN RED CROSS.*

By CLARENCE A. NEYMANN,

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After a description of the conditions which led up to a systematized treatment of mental cases in the German Army, the various types seen in the base hospitals are portrayed. The psychoneuroses fell into three main groups.

One of these groups stood out before all others and was of course immediately labeled. It was called "Granatfieber," grenade fever. These individuals, at least those that came under my observation, were usually stoop-shouldered and narrow-chested. They had a poor physical build and a naturally weak constitution. All complained of indigestion (the hospital served good though rather coarse food), backaches and headaches. However, they fell in with the routine pretty well and only showed symptoms when the experiences at the front were dwelt upon. Then, especially when grenades were mentioned, they immediately grew pale, trembled, and in some cases so far lost control of their legs that they fell down. After such an experience they were restless and nervous and could not sleep without hypnotics for a number of days. This reaction was not necessarily dependent upon the question of their return to the front, but could be brought about by a mere casual mention of explosions, grenades, shells, mines, etc.

A second class that was fairly distinct consisted of those individuals who had had especially trying experiences and then simulated some internal or mental disorder, for which men in their company had been sent to the rear. This simulation often persisted for months even after they were told that they were unfit for duty in the field. One of my patients had attacks of pseudo-epilepsy so manifestly genuine that the reacting pupils during the attack and the account of events immediately preceding the first attack were the only things that clinched the diagnosis.

From this to mere slackerdom, which we may possibly consider as a third group, is but a step and one sees all intermediate stages. It is hardly to be wondered at that a man who naturally has not much strength of character grows tired after months of trench life and quits, either by exposing himself or by simulating some disorder.

Quite opposite from the reaction of these naturally weak and neurotic individuals is that of those slightly mentally deficient. The troops from Bavaria are notably brave and yet among their wounded one finds many high-grade morons. Such individuals usually make good soldiers.

Besides these main types of mental disturbances all sorts of individual reactions were observed. Patients who had gone through depressions in previous years again became depressed. Hypo-manic individuals became very wild and lost almost the last remnants of civilization. Just after the return from the front the behavior of this last class was such that they were exceedingly difficult to control and constantly broke the hospital routine. All these facts agree with our modern psychiatric view of the specific reaction of each individual.

* The Journal of Mental Hygiene, July, 1917.

NOTES ON NEW BOOKS.

A Manual of Pharmacology, and its Applications to Therapeutics and Toxicology. By TORALD SOLLMANN, M. D. Cloth, $4.50. (*Philadelphia and London: W. B. Saunders Co., 1917.*)

A Laboratory Guide in Pharmacology. By TORALD SOLLMANN, M. D. Cloth, $2.50. (*Philadelphia and London: W. B. Saunders Co., 1917.*)

These two books are intended to take the place of the author's well known manual of Pharmacology which formerly included both. In revising the work, the matter had to be so expanded that two volumes were deemed necessary, one devoted to pharmacology proper and the other to directions for laboratory experiments. It is the ambition of the book, as the author states in the preface, to make it serve both as a text-book and a reference book. A single book which undertakes to fulfill both of these requirements is almost certain to emphasize one at the expense of the other, and the present work is no exception to this rule. Although an attempt is made to differentiate between the more important and less important pharmacological effects by arranging the text in different types, on the whole the Manual of Pharmacology would seem to be more suitable for advanced students and the specialist in pharmacology, rather than for the beginner. Aside from this criticism, the present work is probably the most comprehensive reference handbook on pharmacology in English.

The Manual contains much matter which is not generally included in the ordinary text-book. Thus, in the first part, a great deal of valuable pharmaceutical information is given. Prescription writing, metrology, posology and even coloring and flavoring reagents receive a considerable amount of attention. There are very interesting general remarks on the Treatment of Disease, Chemical Basis of Pharmacology, General Principles of Toxicology and the more important facts concerning Physical Chemistry.

Although the author, as a zealous member of the Council on Pharmacy and Chemistry of the American Medical Association has perhaps unnecessarily curtailed his discussion of certain classes of drugs which have been greatly abused by the profession, such as the antipyretics, most of the more important pharmacological groups of drugs receive adequate consideration. The treatment of Anesthetics and the discussion of the Theories of Narcosis are especially good, and no less so the descriptions of the Atropin group, of Strychnine and of the Ergot alkaloids. A great many newer remedies and reagents are noted, such as the more recent organic Arsenicals, Optochin, and various organic preparations. There is also an interesting though brief description of Radium and other radioactive substances and of colloid metals. Although the Manual, like all text-books, is some five years behind the times, there is certainly an attempt made to include the references to all of the most important recent work in pharmacology. The literary index at the end, while not complete, will be found very convenient by the investigator as a starting point for tracing out the literature on the more important subjects.

The Laboratory Guide, like the Manual, describes a great many experiments, for instance, vividiffusion, which can be performed only by the specialist. All the ordinary pharmacological experiments, however, are fully given, making it convenient for teaching purposes. The first part is devoted mainly to chemical experi-

ments and pharmacognosi; the second part deals with more purely pharmacological experiments. A list of dosages for animals is appended. On the whole, the Manual of Pharmacology and the Laboratory Guide Book will be found very useful handbooks by every pharmacologist and should be on the reference shelf of every laboratory. D. I. M.

Cardio-Vascular Diseases. By Dr. Thomas E. Satterthwaite. (*New York: Lemcke and Buechner, 1912.*)

In a subject in which there has been so steady and so definite advance as has taken place in cardio-vascular study, it is difficult to review fairly a book written five years ago. In Dr. Satterthwaite's book, which represented the book-form presentation of a collected series of his monographs up to 1912, one is, of necessity, struck by omissions, which are interesting in the fact that one thereby comprehends the advances made in the understanding of cardiac activity—especially since the author states that he has tried to limit himself to the description of those "newer" features of the subject that have a definite bearing on diagnosis and treatment.

The illustrations are not distinctive and are in no small part cuts of different instruments that would obtain in an outfitter's catalogue. The electrocardiograms are poorly reproduced and are characterized somewhat by splintering. The text represents a few general lectures to post-graduates who have been out of touch with university opportunities and who are particularly interested in treatment. Many of these would probably be attracted by the use of the high frequency current and carbon dioxide, rather than by the more practical but less impressive therapy resulting from a quiet study of the patient's life, with a readjustment of the relationship between rest and activity to the end that the demands on the heart may be less than it can supply. E. W. B.

Studies in Blood-Pressure—Physiological and Clinical. By George Oliver. Third edition. Cloth, $3.00. (*New York: Paul B. Hoeber, 1916.*)

The death of Dr. George Oliver, at Christmas time, 1915, was a sad loss to the many friends in his native land and the privileged few on this side the Atlantic who had been permitted to pass beyond the appreciation of his published work to the knowledge of one of the most lovable of English gentlemen. To be numbered among the latter was the good fortune of the reviewer, who welcomes this opportunity to record his admiration for the earliest and foremost English-speaking student of blood-pressure, and his affection for a nature overflowing with kindliness and goodwill. He combined thorough physiological training with ripe clinical experience, and his writings reflect the intimate blending of the two. Constant interest in the underlying mechanisms and their elucidation, balanced by practical wisdom, makes this last edition of his book of unusual value to every physician who wishes to base his treatment of hypertensive patients on sound theory and sane clinical observation.

The first edition of Dr. Oliver's "Studies in Blood-Pressure," published in 1901, blazed a narrow trail into the then unexplored domain of clinical sphygmomanometry. The second, in 1908, much enlarged and rewritten, recorded the great progress ahead made. At the time of his death he had fortunately almost completed a third rewriting, which contained all the important additions to knowledge and method which had accrued in the interval. Happily his friend, Professor Halliburton, at once took charge of the publication of this third edition, which appeared last summer.

The book is admirably suited to the needs of the practitioner. It contains all the essential bibliographic references, but no others, and has none of the features of a compilation. It is primarily the straightforward exposition of existing physiological and clinical knowledge of human blood-pressure and its disorders by one who sought always to improve his own methods of diagnosis and treatment. The chapters on fundamental data are quite free from that pseudo-physiology, which is so harmful to the mind that falls under its spell. The chapters dealing with method are absolutely clear and set forth all the sources of fallacy in clinical measurements, whether oscillatory or auditory, and how they may be avoided. The treatment outlined is conservative, but real. Dr. Oliver treated large numbers of hypertensives during his years of practice at Harrowgate and knew how much he could help them, as well as how to avoid doing them harm. The concluding chapters on arteriometry and on venous and capillary pressures show the breadth of his interest in the relation of all the elements of the peripheral vascular mechanism to the maintenance of a normal circulation. It is to be hoped that English-speaking physicians generally will avail themselves of the knowledge Dr. Oliver has made so accessible for their guidance in caring for one of the most important groups of their patients. T. C. J.

Pharmacology and Therapeutics. By Horatio C. Wood, Jr. Second edition. Cloth, $4.00. (*Philadelphia: J. B. Lippincott Co., 1916.*)

The new edition of this work makes it a thoroughly complete text-book of present day drugs and their practical application. The pharmacology is carefully brought up to date and concisely and pleasingly presented. Therapeutics are limited to the Action of Drugs almost entirely. The volume does not attempt to deal with the many general and special therapeutic problems outside the realm of drug treatment, but such a limitation of scope is necessary in a book of its size. The discussion of the use of drugs in disease is, however, essentially practical, complete and full of sound clinical advice.

One must take issue with the statement on p. 226 that Addison's Disease of the adrenal glands is "usually cancerous" in nature. The classification of the Anæmias seems rather to sacrifice accuracy to brevity. They are divided into Accidental Anæmia, in which there is said to be an equal reduction of hæmoglobin and red blood cells; Chlorosis, in which there is a relatively greater reduction of hæmoglobin; and Pernicious Anæmia, in which the red cells especially are reduced. If one accepts this classification, he is forced to include under the diagnosis of Chlorosis many cases of secondary anæmia of varied origin, which bear no relation to Chlorosis as a clinical entity.

Dr. Wood's book is as complete, scientific and practical presentation of the action and use of drugs as could be contained in a single volume of 455 pages. J. T. K., Jr.

Materia Medica for Nurses. By A. S. Blumgarten, M. D. Second edition. Cloth, $2.50. (*New York: Macmillan Co., 1916.*)

This is much like other books of a similar nature—a condensed summary of an important subject. In fact, it is so concentrated as to be more like a dictionary than a text-book. For hasty reference to preparations and dosage of drugs it would be very useful and probably is as good a book as one could get to cover a large subject in a few words. For a nurse of investigating mind it would prove inadequate, yet one can find very quickly the salient facts about Materia Medica.

The author speaks of a Cardiac Stimulant as a drug which "makes the heart beat stronger and faster." This is rather too dogmatic, as our common cardiac stimulants, digitalis and strophanthus, decrease the rate of the heart and the nurse should know it. The same quotation illustrates the rather frequent use of the adjective for the adverb where the latter is clearly intended.

On the whole, the work is accurate and is a good handbook for a nurse at work. J. T. K., Jr.

Report of the First Expedition to South America—1913. Harvard School of Medicine. (*Cambridge: Harvard University Press, 1915.*)

This volume is a model of its kind. The subjects dealt with at greatest length in the report are Verruga Peruviana and Oroya Fever. These conditions, formerly believed to be different manifestations of the same disease, the authors have definitely separated into distinct clinical entities. Case histories, detailed records of clinical investigations, pathological reports, animal experimentation and some entomological study are all carefully given. As the result of this work is has been shown that Oroya Fever—a disease associated with fever and intense anæmia, and having a high death-rate—is caused by a microorganism, previously described by Barton and called *Bartonella bacilliformis.* This protozoon is a parasitic invader of the red blood cells and of the endothelial cells. All attempts at animal inoculation yielded negative results. Although not definitely proven, an arthropod is believed to be the intermediate host.

Verruga Peruviana—a disease with some fever and slight anæmia—is characterized by definite skin eruptions. No microorganisms have been discovered, but animal experiments, especially with monkeys, have yielded beautifully positive results. A filtrable virus is supposed to be the etiological factor, but so far this has not been definitely proven.

The finding of both diseases in the same individual and the further obscuring of the pictures by the prevalent malarial infections and by paratyphoid have all been largely responsible for the confusion concerning these two conditions.

The work also contains a short consideration of the clinical picture, pathology and etiology of Uta—an ulcerative inflammatory skin infection—prevalent in Peru. A species of Leishmania is shown to be the etiological factor in its production.

There is also an account of the negative results from efforts to confirm Seidelin's findings in the red blood cells in cases of yellow fever. Another interesting article is that on various flies and mosquitoes brough back from the trip. A new linguatulid found in crocodiles in Ecuador is also described.

The splendid illustrations throughout the book are a valuable addition to the text. M. D. B.

The Diagnosis and Treatment of Abnormalities of Myocardial Function. By T. STUART HART. (*New York: The Rebman Co., 1917.*)

It is a pleasure to review so interesting a book as has recently been presented by Professor Hart of Columbia. Abnormal Myocardial Function is a successful attempt to give physicians and students the present status of cardiac physiology—both normal and pathological—especially as obtained by the newer methods of study. It exemplifies the clinical application of the laboratory in this particular field. Illustrations are plentiful and, pleasantly enough, they are practically all original. The electrocardiograms are excellent and are, all in all, among the best reproduced both for their text application and their technical appearance. Although there may be conclusions to some of Professor Hart's deductions and although occasional statements are possibly too dogmatic, in view of the existing evidence, the book is unquestionably one of the best in its field, theoretical possibilities being balanced by good hard sense. The references are good and represent a thorough familiarity with the literature. E. W. B.

The New Method in Diabetes. By J. H. KELLOGG, M. D. (*Battle Creek, Mich. Good Health Publishing Co., 1917.*)

This small book represents an effort at a complete summary of our knowledge of diabetes in a very few pages. Under these circumstances, the logical sequence of the text is necessarily halting, and it is difficult for the reader to follow the flow of thought, unless he is well acquainted with the subject. The mode of treatment advocated by Dr. Kellogg, a low meat dietary with a disproportionate amount of fat, especially in cream, and a considerable quantity of starch in vegetables, is somewhat contrary to the usual treatment accepted as a standard one to-day. However, it seems to have yielded results in the hands of Dr. Kellogg, and the recipes furnished may be of definite aid to those who wish to follow his lead. M. D. B.

Practical Therapeutics. By H. A. HARE. Sixteenth edition. Cloth, $4.75. (*Philadelphia and New York: Lea & Febiger, 1916.*)

As in preceding editions, this book is divided into four parts. The first, entitled "General Therapeutic Considerations," gives the usual introductory information regarding weights and measures, prescription writing, drug incompatibilities, etc. In the second, headed "Drugs," is found a list of the medical therapeutic agents, including those listed in the new U. S. P. and the New B. P. There is given a short account of the physiological action of each drug together with its therapeutic use and the results of overdosage. Under "Remedial Measures other than Drugs" and "Feeding the Sick," the heading of the third part, are described procedures varying from all forms of hydrotherapy and thermotherapy to serum treatment, transfusions, kataphoresis, acupuncture and the preparation of food for the sick. "The Treatment of Disease" is discussed in the last part. G. E. de Schweinitz has contributed the articles on diseases of the eye; B. C. Hirst, those of the puerperal state; E. Martin has written on antisepsis, gonorrhea and syphilis. Practically all the common disorders are discussed, including even such things as the medical handling of anal fistula and alcohol injections for trigeminal neuralgia.

With its alphabetical arrangement of subject matter, the book is well planned for ready reference. The combined collection of scientific and empiric information gives the work, however, a pseudo-scientific coloring. To have emphasis laid on the cure of lumbago by the insertion of sterile needles into the back muscles and to read that malaria is "*practically* always the result of a mosquito bite" is rather startling information to be given in a scientific work of to-day. The directions for alcohol nerve injections make the procedure sound so simple as to incur the danger of enticing those totally unskilled for such a procedure into an attempt. The formula for Dakin's solution also sounds very easy, whereas in reality the knowledge of a good chemist is needed.

If perhaps the scope of the book had been less broad and the consideration of the various topics a little more deep and, in some cases, more accurate, the results would have been more acceptable to the truly scientific medical man. M. D. B.

The Growth of Medicine. By ALBERT H. BUCK, M. D. Cloth, $5.00. (*New Haven: Yale University Press, 1917.*)

Most of our information we take on faith, believing as facts most of the data that are transmitted to us because they are generally accepted or else come burdened with the overpowering weight of authority. The common facts that rule our lives and guide our daily prudence we clothe with an absolute truthfulness, building the universe upon their necessary existence. Only the recondite philosopher is interested in the nebulous antiquity of the mind when first it groped to consciousness and welded these simple but powerful mental tools from the dim memories of ages of struggle. The discoveries of later years, and especially the novelties of modern science, arouse our profound interest and astonishment, but wonder nearly always exceeds curiosity and complacency usually throttles both. We must, of course, accept most of our knowledge upon such simple faith; we could not, if we would, investigate the foundation of it all. However, there is always a small part of human knowledge and experience in which we daily work and live, and of this small part we must know the

facts, if we are fully to appreciate its present problems. A truth is never so appealing as when we are familiar with the slow steps of progress upon which it has been built. We never wholly grasp its force unless we know the underlying data from which it is derived and the methods that gave them birth. From this broad perspective we see principles and practice in their true light, not as final, settled opinions but as a shifting platform of human endeavor gained after ages of restless struggle from which man reaches out eagerly and hopefully for new adventures and conquests.

To have this perspective is to know the history of the phase of human endeavor that engages our attention. We physicians are notoriously insensible to the worthy and inspiring past of our art. The age is so full of absorbing discoveries, and the demands of practice are so exacting that it is enough for ordinary zeal and interest to keep abreast with the advances of the day. Nevertheless to be imbued with the spirit of this advance, to taste the real flavor of progress, we must have a thought for the tillers who prepared the soil for our rich harvest, an appreciation of their labors, with a knowledge of the difficulties they encountered and of the rude instruments with which they overcame them. Dr. Buck's book will prove to many a solution of the conflicting demands of practice and scholarship. In brief compass and in entertaining style he sketches the history of medicine. Every physician can get information and pleasure from reading it. No doubt it will prove a stimulus to interest in the history of medicine among the profession of America, and it is to be hoped that it may arouse a chosen few diligently and intensively to cultivate this neglected corner of our art. L. H.

The Development of the Human Body. A Manual of Human Embryology. By J. Playfair McMurrich, A. M. Fifth edition. Cloth, $2.50. (*Philadelphia: P. Blakiston's Son & Co., 1915.*)

The fifth edition of this popular manual of human embryology is even more compact than its predecessors and, like them, reflects the careful work of the author in bringing the contents up to date. The well known merits of this volume, which have been dealt with in reviews of the earlier editions, do not need reiteration here, and attention will be directed principally to the evidences of revision. Among these may briefly be mentioned the section on spermatogenesis (p. 13) which has been largely rewritten, and includes a reference to the latest investigations upon the accessory chromosomes. It is of interest to note that the spermatogonia which are destined to become Sertoli cells are characterized by containing a curious rod-like crystalloid—the anlage, apparently, of the crystalloids of the mature sustentacular cells; also that the spiral filament of the spermatozoön is now regarded as having been developed from the "cytoplasmic plastosomes" instead of merely from the "cytoplasm," as in the last edition. Indeed the recent interest manifested in cytoplasmic bodies in general, in their relation to cell differentiation, is represented in the sentence which the author devotes to the mitochondria (p. 4). The former description of the origin of the sex cells has been modified to include the views of Fuss (p. 346), who derives these elements in the human subject from the endoderm of the digestive tract.

On page 25 the more recent views as to the function of the corpus luteum verum are set forth; here also Bischoff's theory of the origin of the lutein cells from the granulosa cells is considered to be well established rather than an open question, as heretofore. A new paragraph, illustrated by a diagram, is added, containing the results of recent work on the pronephric system (p. 336).

The wide field of human embryology is covered in an astonishingly comprehensive manner considering the small compass of the book, but, on account of the limitation in space, an exhaustive discussion of all points has not been possible. Thus only one of the several hypotheses dealing with the metamorphosis of the red blood-corpuscle—that which postulates an extrusion of the nucleus apparently *en masse*—is presented (p. 223).

To designate the differentiation of certain cells of the dermis into fat cells the pathological term "fatty degeneration" is used (p. 141). Again, the basophile cells of Ehrlich (p. 225) are regarded as leucocytes in process of degeneration—a view with which not all hematologists will agree. It should be mentioned here that the terms "polymorphonuclear" and "polynuclear" which the author links with the basophile leucocyte are usually applied to the neutrophile.

The epiphyseal cartilage (p. 154) is said to be transformed into bone on *both* its surfaces, and although this is strictly true, yet the growth is so much greater on the diaphyseal side that some authors (Macewen) prefer to speak of the "diaphyseal cartilage."

The text is splendidly illustrated, the figures being abundant, well chosen and frequently original. It is, indeed, difficult to see how the volume could be improved in this respect unless, perhaps, a good diagram, giving a view from the front, were added to assist in the description, on page 325, of the complicated attachment of the mesentery to the dorsal abdominal wall.

On the whole it can be said without a doubt that the work is easily the best in its field, and the fact that it is now in its fifth edition (the advent of which is only two years removed from that of the fourth) speaks eloquently for the high esteem in which it is held by the profession and student body of biologists in general and medical biologists in particular. It is safe to say that this issue will enjoy an even fuller measure of prestige than any of its forerunners. C. C. M.

BOOKS RECEIVED.

Elements of Anatomy and Physiology for Nurses. By Percy M. Dawson, M. D. 1917. 12°. 279 pages. Macmillan Company, New York.

Association of American Physicians. Transactions. Volume XXXI. 1916. 8°. 515 pages. Printed for the Association, Philadelphia.

The Breast: its Anomalies, its Diseases, and Their Treatment. By John B. Deaver, M. D., LL. D., Sc. D., and Joseph McFarland, M. D., Sc. D. Assisted by J. Leon Herman, B. S., M. D. With 8 colored plates and 277 illustrations in text. 1917. 4°. 724 pages. P. Blakiston's Son & Co., Philadelphia.

Cataract, Senile, Traumatic and Congenital. By W. A. Fisher, M. D. 1917. 8°. 119 pages. Published by Chicago Eye, Ear, Nose and Throat College, Chicago.

New York Obstetrical Society. Transactions. Volume for 1911-1913; volume for 1913-1916. Edited by George W. Kosmak, M. D. Reprinted from the *American Journal of Obstetrics.* 8°. William Wood & Company, New York.

Studies on Aerobic Spore-Bearing Non-Pathogenic Bacteria. From the Laboratory of Hygiene and Bacteriology, Johns Hopkins University. By W. W. Ford, C. A. Laubach, J. S. Lawrence, J. L. Rice. 1916. 8°. 533 pages.

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